The Effect of Patient Simulation on the Critical Thinking

Of Advanced Practice Nursing Students

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Dedications

This dissertation is dedicated to my husband Michael, who provided me with undying love and support during the five years of coursework, writing, data collection, data analysis and final defense. Without your support, this dissertation would never had reached its completion.

This dissertation is dedicated to my three sons, Joseph, Christopher and Stephen, whose mother did not make it to every game or school trip or party, but tried to support them as much as possible. Thanks for hanging in there with me, for helping around the house and for taking care of one another when I was studying, reading or writing.

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Abstract

The Effect of Patient Simulation on the Critical Thinking of Advanced Practice Nurses

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Nurse educators attempt to develop critical thinking of nursing students through a variety of instructional methods because they are unable to prepare students for every situation they may encounter. Problem-based learning is the traditional method used. Case analyses conducted in classroom settings have yielded varied results. Recent reports hail high fidelity, patient simulators as an effective tool to enhance critical thinking however, little empirical data exists to support these claims. The current study set out to examine the effect patient simulation has on the critical thinking of nurse practitioner and nurse anesthesia students. Case analysis sessions conducted in the face-to-face format were compared to those sessions conducted around a patient simulator. Participants completed the California Critical Thinking Skills Test (CCTST), which includes subscale scores for induction, inference and analysis, to establish a baseline measure of their critical thinking. Participants were then randomly assigned to either format and further randomly assigned to complete one of two cases. All sessions were videotaped and behaviors and discussion were coded using a scoring tool based on Garrison's Stages of Critical Thinking. According to Garrison's Five Stages of Critical Thinking, individuals are said predominantly to use the elements of induction, inference and analysis in the planning phase. Data analysis revealed patient simulation to increase critical thinking during the management planning and evaluation stages. The current study has provided additional empirical evidence supporting the use of simulation during problem-based learning, case

analysis to enhance critical thinking, especially during management planning when advanced practice, nursing students formulate creative solutions to the problem, link ideas and make assumptions. Critical thinking was also increased during the evaluation stage when decision-making is a large component and includes an evaluation of progress and mistakes made and a determination of what more must be done. By enhancing critical thinking in these two stages, APNs can be better prepared to evaluate and solve the problems faced in clinical practice leading to better patient outcomes.

CHAPTER 1: INTRODUCTION

The purpose of Advanced Practice Nurse (APN) education is to prepare the graduate to assume responsibility and accountability for the health promotion, assessment, diagnosis and management of patient problems including the prescription of pharmacological agents within a specialty area of clinical practice (American Association of Colleges of Nursing [AACN], 1996). According to the AACN (1996) the primary goal of the nursing education's master's degree is to assure that the APN possesses strong critical thinking skills and the ability to critically and accurately assess, plan, intervene and evaluate the health and illness experiences of clients (individuals, families and communities). Oftentimes APNs, a title that includes nurse practitioners, clinical nurse specialists, nurse anesthetists and nurse midwives, are faced with patient care situations in which critical thinking skills are utilized in an attempt to prevent serious harm from occurring. The challenge to nurse educators is to assure that the critical thinking skills necessary to respond to dynamic, patient situations are developed in APN students before they graduate.

While teaching APN students to think critically is a major priority of nurse educators, it has not been found to be an easy task. This may be due in part to the fact that nurses have not embraced a single definition of critical thinking. Another factor may be that no consistent method or approach has been adopted for teaching critical thinking and lastly, no specific method or instrument has been developed that has been used repeatedly and reliably to measure the critical thinking of nurses.

However, a growing body of literature describes case study analysis as an effective approach for teaching critical thinking, although few studies are found examining this phenomenon. More recently, articles describe how nursing programs are incorporating human patient simulation into case analysis sessions. The articles report this technique as a way of simulating the patient scenario in a safe environment while purporting to enhance the critical thinking of the student participants. Again, these reports are anecdotal and not research based.

Before it is possible to study how a particular curricular approach affects critical thinking, one must first understand the construct of critical thinking. Nurse educators often define critical thinking by describing how members of other disciplines have conceptualized it or by explaining how various aspects of critical thinking are demonstrated in a clinical setting. Since no one definition has been accepted by nurse educators, a discussion of how critical thinking began to be considered a foundational element of education is presented. This is followed by a discussion of how nurse educators conceptualize critical thinking.

The Construct of Critical Thinking

Critical thinking has been described as an integral part of business and economic success. In his discussions, Dewey (1916) described the essence of critical thinking as suspended judgment in an effort to determine the nature of the problem before proceeding in trying to solve it. Dewey (1916) suggested that analysis and synthesis of the problem were necessary components of critical thinking. He described analysis as picking apart the elements of a problem and identifying its components, followed by a restructuring of the problem including incorporating the solution, which he referred to as synthesis (Dewey, 1916). Dewey and others claimed it was imperative that all citizens know how to think critically to assure the success of the country. Dewey's influence as an economist and educational philosopher continues to guide educational policy, and the way numerous professions consider critical thinking, including nursing.

Critical Thinking in Nursing

It is impossible for nursing educators to teach nurses how to handle every situation. Critical thinking is an important skill for nurses to possess because when faced with uncertain or novel experiences, nurses are expected to respond to the situation or issue appropriately. It is expected that nurses will be confronted by a growing number of situations requiring critical thinking skills, due to the dynamic changes occurring in health care. Additionally, the explosion of health care technology requires nurses to apply principles learned in nursing schools to new situations. Nurse educators agree that critical thinking skills are essential tools for practice. A discussion of how critical thinking is conceptualized and taught and how students develop critical thinking skills follows.

The National League for Nursing (NLN) (1991), an accrediting body for academic nursing programs, mandated that critical thinking content be included in all nursing curricula. However, no unitary definition of critical thinking in nursing had been adopted. The NLN provided no definition of critical thinking, but in the evaluation criteria described analysis, reasoning, research and decision-making skills resulting from thinking (NLN, 1991). Since the NLN mandate, nurse educators have written several books and articles conceptualizing how critical thinking could be applied to nursing and taught in the curriculum (Alfaro-LeFevre, 1999; Pesut & Herman, 1999; Lowenstein & Bradshaw, 2001; Miller & Babcock, 1996; Rubenfeld & Scheffer, 1995; Haskvitz & Koop, 2004; Paparella, Mariani, Layton & Carpenter, 2004; Henneman & Cunningham, 2005). Definitions of critical thinking by nurse educators are discussed in the following section.

Nurses' Definitions of Critical Thinking

In a Delphi study conducted by the American Philosophical Association (APA), in 1990, critical thinking was described as the process of purposeful, self-regulatory judgment and an interactive, reflective reasoning process. Thiele (1993) described the same elements in her description of clinical decision-making. Boostrom (1994) defined critical thinking as a way of looking at reasons for believing one thing rather than another in an open and flexible manner, while paying attention to details. Kyzer (1996) described critical thinking as a process of choosing, weighing alternatives and considering what to do next. All of these definitions clearly emphasize the concept of open-mindedness. Critical thinking is defined by some as the thought process underlying effective clinical problem solving and decision making (Oermann, 1997; Oermann & Gaberson, 1998; Oermann, Truesdell, & Ziolkowski, 2000), thus providing the contextual aspect to the definition. Wallace (1996) and Sedlak (1997) both added a reflective component to this definition. Miller and Babcock (1996) described critical thinking as purposeful thinking that takes into consideration focus, frame of reference or context, evidence, facts, attitudes, assumptions, reasoning, conclusions and implications, again emphasizing the context in which critical thinking occurs. Alfaro-LeFevre (1999) defined critical thinking as purposeful, goal directed thinking that uses scientific method directed towards making judgments. This definition built on the already embraced approach used by nurses, the nursing process. The five steps of the nursing process include assessing, identifying the problem or diagnosing, developing a plan, implementing the plan, and evaluating how well the plan worked.

These definitions suggest that critical thinking occurs within the context of problem solving or decision-making. They suggest that the critically thinking individual must remain flexible and open-minded while considering options and reflecting on the thinking that is being done. It is important to note that critical thinking is an active process directed towards making judgments or decisions.

Nurse educators often equate the nursing process with the scientific method. Nurses use the nursing process of assessment, interpretation, planning, implementation and evaluation of a problem as *the* method to use when attempting to solve a patient problem or issue. Many definitions liken critical thinking with clinical reasoning, clinical judgment and decision-making, while others argue that critical thinking is a component of a larger problem-solving process (Oermann, 1997; Oermann & Gaberson, 1998; Oermann, Truesdell, & Ziolkowski, 2000). Since the nursing profession does not embrace one definition, many nurse educators and scholars have used the characteristics of critical thinkers as a way of defining critical thinking itself (Watson-Glaser, 1964; Brooks & Shepherd, 1990; Facione, Facione & Sanchez, 1994; Facione & Facione, 1996; Kamin, O'Sullivan, Younger & Deterding, 2001).

Critical Thinking and Problem-Based Learning

Critical thinking accompanies a movement in education toward inquiry-based or problem-based learning (Ricketts & Rudd, 2002). Further, DeMarco, Hayward & Lynch, (2002) observed that students learn best when preparing their own questions based on their observations, rather than participating in a predetermined exercise with preconceived conclusions. Such statements support the use of problem-based learning, an approach that has been embraced by many nurse educators.

Nurse educators often use problem-based learning in the form of case study analysis as a way of teaching critical thinking. Problem-based learning involves in-class discussions of clinical situations in which students explore the many answers to a problem or situation (Inouye & Flannelly, 1998). Students are expected to search their knowledge base and apply these principles to the situations. Problem based learning is believed to promote the cognitive processes that support clinical reasoning and critical thinking. The students' learning is active and, instead of providing a large amount of information that will soon be forgotten, a problem-based learning approach provides the structure and process for learning to occur (Inouye & Flannelly, 1998). Critical thinking is an essential component of problem-based learning. Reflective, well-informed thinking, flexible and fair-minded, prudent in decision making, diligent in seeking relevant information, and persistent in seeking results as precise as the subject permits are characteristics of critical thinking and critical thinkers that a problem-based learning approach purports to promote.

Problem-based learning has components within it that allow for self-directed learning, as some cases are provided to students to work on individually. Students also may be required to work within cooperative groups, in which portions of the case are assigned to individuals, thus promoting a collaborative atmosphere. Ousev (2003) posits that problem-based learning supports the type of learning most often encountered in clinical practice. By collaborating with colleagues when engaged in problem-based learning activities in the classroom setting, students learn the value of working with others; a skill that hopefully carries into their actual clinical practice. Alexander, McDaniel, Baldwin & Money (2002) add that problem-based learning allows for socialization of the student as a colleague and professional. Still, despite numerous nurse educators' support of the problem-based learning approach, its effectiveness has been inconsistently demonstrated.

The inconsistency in the results of the problem-based learning approach is the reason that some nursing programs are turning to other approaches to teach critical thinking. The method most recently reported in the literature is the incorporation of human patient simulators into PBL sessions. Analysis of a clinical scenario remains the basis of the learning session. The difference is that an interactive patient simulator is used to demonstrate the symptoms of the patient presented in the clinical scenario. As students respond to the unfolding scenario, the simulator responds to the judgments made by the students, without any possibility of causing harm to a patient. Additionally, the multi-dimensional aspect of the simulator, psychomotor, cognitive, affective and sensory, allows students to see the changes in patients' conditions as their care decisions are implemented and to react responsively.

Human Patient Simulation

Human patient simulation adds another dimension to the problem-based learning approach to teaching critical thinking. By using human patient simulation, the students involved in case analysis are provided additional visual and sensory input not provided in face-to-face discussions alone. When considering the generic influences of learning presented by Reisman and Kaufman (1980), the multi-sensory, social and emotional environment produced by including patient simulation into case analysis session provides a more sensory and contextual environment, thus promoting more meaningful learning.

It is important to understand what a human patient simulator is in order to understand the potential impact of its use.

A human patient simulator (HPS) is a full-sized, interactive, high fidelity (highly realistic), mannequin that can be programmed to demonstrate the signs and symptoms of the patient described in a problem-based learning scenario. Additionally, the simulator has the capacity to respond dynamically to the decision making of students as they learn. Using complex computer technology and a highly specialized hydraulics system, the HPS has palpable arterial pulses, blood pressure monitoring capability, chest movements consistent with breathing, heart and lung sounds, and anatomically correct landmarks for airway management (Bower, 1997). Depending on the model, the mannequin may have many other interactive features. The computer interface allows for real-time display and monitoring of the electrocardiogram (ECG), pulse oximetry waveforms, and end-tidal carbon dioxide monitoring waveforms (Bower, 1997). Oftentimes, the HPS is housed in a room with monitors, mechanical ventilators, and other equipment and supplies that enhance the realism of the environment. If completion of the problem-based learning scenarios requires the use of additional equipment or supplies, they are made readily available in the room. The physical layout of the simulation room can be made to mirror an actual hospital room. By providing a realistic environment for learning, students more easily believe that the situation is actually occurring and thereby respond accordingly (DeMarco, Hayward, & Lynch, 2002).

Many advantages to incorporating human patient simulation into problem-based learning scenarios are reported in the medical literature. Some of these are: a) presentation of uncommon critical scenarios in which a rapid response is needed; b) error management situations that allow students to see the results of their mistakes; c) multidisciplinary team approaches to the management of patient problems; and d) development of procedural skills without risk to patients (Gaba, Howard, Fish, Smith, & Sowb, 2001). Although there are only a few nursing studies examining the effectiveness of simulation in the development of critical thinking skills, many hope that these findings will favorably influence learning outcomes. To date, the nursing studies that have been conducted have examined how computer adaptive simulations affect critical thinking skill development (Ravert, 2002; Goolsby, 2001; Chu, 1998; Madorin & Iwasiw, 1999; Weiss & Guyton-Simmons, 1998; Merril & Barker, 1996; Cohen & Dacanay, 1994; Lantier, 1992; Yuill, 1992; Sylvia, 1989).

Only one nursing study, found in the nurse anesthetist literature, examined the effectiveness of using human patient simulation on the critical thinking skills of students trained through this approach (Henrichs, Rule, Grady & Ellis, 2002). The nurse anesthetist students in this study participated in four simulation sessions in which patients had untoward events such as a difficult airway intubation, dramatic drop in blood pressure and an unexpected reaction to anesthesia. The researchers observed the students' performance during the simulated scenarios. Students were asked to maintain a journal of their performance feelings about the simulated sessions. Participants were interviewed after completing all four sessions. Interviews focused on the participants' opinion of how the sessions were designed, how the student performed during the sessions and the realism of the simulated scenario. Hendrichs et al. (2002) concluded that incorporating HPS into the learning sessions improved students' critical thinking. Although these findings are favorable, more research is needed to support the use of this expensive, complicated and often resource-intensive supported approach to learning. However, it is important to investigate the effectiveness of this method, as using a simulator instead of an actual patient is a more favorable teaching method than teaching in actual clinical situations, as discussed below.

Ethical Imperative

Nurses and physicians have long used actual patient situations for the training of students. Bioethicists and others have often criticized this practice based on the patient burden resulting from care provided by novices (Gordon, Wilkerson, Shaffer & Armstrong, 2001). The advent of using problem-based learning framed around a simulator may be one way to avoid using patients for learning while continuing to provide the student with a meaningful learning experience (Sequeira, Weinbaum, Satterfield, Chassin & Mock, 1994; Ashish, Bradford & Bates, 2001; Gordon, Wilkerson, Shaffer & Armstrong, 2001). If human patient simulators are found to be effective teaching tools for development of critical thinking skills, they may make a profound impact on the way in which nurses and physicians are taught.

Identification of the Problem

There are a growing number of nursing programs reporting the purchase of human patient simulators and incorporating their use with problem based learning (Fletcher, 1995; Monti, Wren, Haas & Lupien, 1998; Fallacaro & Crosby, 2000; Hotchkiss & Mendoza, 2001; Vandrey & Whitman, 2001; Hotchkiss, Biddle & Fallacaro, 2002; Haskvitz & Koop, 2004; Paparella, Mariani, Layton, Carpenter, 2004; Henneman & Cunningham, 2005; Hravnak, Beach & Tuite, 2007). The ability of these simulators to allow participants the opportunity to work through both critical and non-urgent clinical situations without causing harm to patients and to develop critical thinking skills are the two most commonly documented reasons for incorporating their use (Fletcher, 1995; Monti, Wren, Haas & Lupien, 1998; Fallacaro & Crosby, 2000; Hotchkiss & Mendoza, 2001; Vandrey & Whitman, 2001). The problem identified is that little evidence exists in the nursing literature demonstrating the effect of patient simulation in case study analyses sessions. Additionally, the effect of simulation on the development of APN students' critical thinking skills is unclear. According to Kemp (1985), the demonstration of critical thinking in the clinical setting is a universally expected behavior of professional nurses engaged in practice, including nurse practitioners who have direct responsibility for patients’ health outcomes. Moreover, the need to minimize risk when managing patient situations is of utmost importance as every time practitioners interact with patients, the ability to react instinctively and flawlessly is expected (Howard, Gaba, Fish, George & Sarnquist, 1992). However, the expense of purchasing human patient simulators, developing simulation-based scenarios, training educators how to use the simulator and relying on these techniques to be effective is dependent on whether critical thinking skills are actually enhanced. Additionally, only one study (Henrichs, Rule, Grady & Ellis, 2002) specifically examined the effect of incorporating patient simulation on critical thinking skills. Hence, it is premature for nurse educators to go to such expense purchasing a technology that has not been demonstrated to be effective. Therefore, research examining the effectiveness of patient simulators on the critical thinking skills of advanced practice nursing students is needed.

Research Question

This study investigated whether critical thinking, as measured by advanced practice nurse students' discourse and behaviors exhibited during a case study analysis session in which human patient simulation was used, was different than the critical thinking that occurs in face-to-face case analysis sessions, in which no simulation was used. Baseline critical thinking ability was determined before participation in the case analysis sessions. Each case study analysis session was videotaped and later coded by a trained critical thinking behavior coder. The null hypothesis was that nurse practitioner students engaged in problem-based learning in which human patient simulators display the characteristics of the patient described in the scenario, would exhibit no differences in critical thinking behaviors from those students engaged in problem-based learning scenarios conducted in the classroom setting.

Related Research Questions

The facilitator of the case studies has an important role in keeping the analysis moving forward, while teaching students how to consider issues and apply knowledge and principles to the situation. The abilities of the case leader to facilitate the session affect the amount of critical thinking that occurs during case analysis. Therefore, the number of cues given was counted and compared between groups and cases. The number of correct answers was also tallied and compared between groups.

Additional questions considered were how: 1) the number of years of previous nursing experience, 2) the clinical area in which experience was obtained, 3) the type of nurse practitioner program in which the student was enrolled and 4) the demographic information such as age, gender and race, affected the critical thinking. These factors were being considered since some critical thinking studies have considered their impact. A correlational analysis was performed to determine what, if any, relationship existed among these factors.

Study Assumptions

This study was based on two assumptions. First, case study analysis framed around patient simulators provides a multi-sensory, social, emotional and contextual environment for learning, in which nurse practitioner students were engaged not only cognitively but also through visual, auditory, psychomotor, social and emotional cues, much like the real clinical situation. The importance of creating a multi-sensory, social and emotional environment for learning was supported by the work of Reisman & Kauffman (1980) who identified generic influences on learning including cognitive, visual, auditory, psychomotor, social and emotional factors. Reisman & Kauffman (1980) suggested that these factors be considered when creating a learning environment, as well as when considering the learner-centered needs of participants. By incorporating human patient simulation into a problem-based learning session, many generic influences on learning are included in the learning environment.

The second assumption was that the critical thinking definition and attributes identified in the Delphi study of the American Philosophical Association (APA, 1990) are exhibited by APN students engaged in the critical thinking process. Many of the APA attributes were included in the list of behaviors identified by Kamin, O'Sullivan, Younger and Deterding (2001). Kamin and colleagues (2001) replicated an earlier study by Newman, Webb & Cochrane (1995) during which five stages of critical thinking – problem identification, problem definition, exploration, applicability and integration were identified and further delineated into sub-categorical behaviors. The researchers in both studies coded critical thinking behaviors of students engaged in problem-based learning discourses. Kamin et al. (2003) further refined this list of behaviors, as seen in Table 4.2. This list was used to code the critical thinking behaviors exhibited by participants, during videotape analysis.

Delimitations of the Study

This study addressed the critical thinking of nurse practitioner and nurse anesthesia students, two subsets of the advanced practice nurse population. There are various subspecialties of nurse practitioner students, all of whom were eligible to volunteer to participate in this study and for this reason, the type of nurse practitioner program, the number of courses completed and the total number of courses required to complete the program was collected. Because the scopes of practice for nurse midwives and clinical nurse specialists vary from nurse anesthetists and nurse practitioners, only nurse anesthetists and nurse practitioner students were included in this study. There were two delimitations to this study. First, limiting the study sample to only these two groups of APN students reduced the ability to generalize results to the other advanced practice nursing groups. Secondly, recruiting subjects from only the greater Philadelphia region was a delimiting factor. There are numerous nurse anesthesia and nurse practitioner programs in this region and therefore the recruiting region was large enough to obtain the desired sample size. By recruiting participants from this region only, the ability to generalize the findings of this study to participants from other areas of the country was reduced.

Limitations of the Study

This study relied on nurse anesthesia and nurse practitioner students to volunteer to participate in this study. Six limitations identified included: 1) Difficulty encountered in the recruiting of currently enrolled students, as they have other obligations that prohibit them from volunteering. 2) The unique characteristics of students who volunteered that the researcher could not control such as a willingness to participate, that students in real learning situations may not have. 3) The same problem-based learning scenarios were used throughout the study. Although every effort was made to prevent any information about the case from being shared, it was possible for participants to share information about the scenario to participants who had yet to be studied. To assist in minimizing this effect, student participants were asked to leave the area around the rooms used for the study after they have completed the scenario. 4) The heightened sense of awareness by participants that something untoward will happen in the learning session could have affected the way participants behave in the session (Seropian, 2003). 5) Some participants have difficulty in suspending their disbelief during the session and hence may not have responded as honestly to the simulated situation as they might in an actual situation (DeMarco, Hayward & Lynch, 2002). 6) Similarly, it is difficult to simulate improved patient outcomes accurately since in real patients, numerous confounding factors are present that are not present in the simulation (Ashish, Bradford & Bates, 2001).

Summary

This study randomly assigned nurse anesthesia and nurse practitioner student volunteers to either a problem-based learning group conducted face-to-face or a problem-based learning group conducted with a patient simulator. Each session was videotaped. Two different case studies were used, one focused on a pulmonary problem and the other on a cardiovascular problem. As case analysis sessions were completed, a trained critical thinking behavior coder analyzed the videotapes and tallied the number of times subjects verbalized critical thinking comments or exhibited critical thinking behaviors, developing an individual and group score. Data analysis was conducted on all 128 participants as they completed the sessions.

A gap clearly existed in the nursing literature regarding the use of human patient simulation in case analysis sessions and its effect on the development of critical thinking skills. This was the case despite the increasing number of nursing programs reporting the purchase and integration of human patient simulation into their curriculum. Since simulation has been demonstrated to have advantages over using real patients in real situations, its effectiveness must be determined before nursing professionals invest much more effort and money in using it.

CHAPTER 2: REVIEW OF THE LITERATURE

The construct of critical thinking incorporates the application of knowledge and skills into clinical reasoning, clinical judgment or decision-making. For advanced practice nurses, the critical thinking skills necessary to manage patient illness or injury must be developed adequately enough during their education in order that these skills are possessed upon the students' graduation. The anticipated outcome from the educational program is that new-to-practice professionals have the critical thinking skills necessary to manage actual clinical situations.

Numerous approaches to teaching and measuring the development of critical thinking skills of nurses and advanced practice nurses are recounted in the literature (Alfaro-LeFevre, 1999; Pesut & Herman, 1999; Lowenstein & Bradshaw, 2001; Miller & Babcock, 1996; Rubenfeld & Scheffer, 1995; Haskvitz & Koop, 2004; Paparella, Mariani, Layton & Carpenter, 2004; Henneman & Cunningham, 2005). Few studies have been conducted in nursing settings to determine the effectiveness of any methods used in teaching critical thinking, and their results have been mixed. Evident in recent literature is that health professionals, including nurses, have begun to incorporate patient simulation into their teaching approaches. Conspicuously lacking from this growing body of literature are efforts to determine the effectiveness of using simulation in developing critical thinking skills.

The review of literature for this study was conducted to address three goals: (a) to determine how critical thinking has been incorporated into the nursing curriculum and the measures used to determine its effectiveness, (b) to determine how patient simulation is used in nursing and medical education for teaching critical thinking skills and (c) to identify gaps in the existing literature. The MEDLINE (1966-March 2007), CINAHL (1982-March 2007), PREMEDLINE (March 2007) and OVID databases were reviewed using various combinations of the following key words: critical thinking (2,478), clinical reasoning (697), clinical judgment (1802), critical thinking and nursing education (290), clinical reasoning and nursing education (9), clinical judgment and nursing education (290), decision-making and nursing education (250), human patient simulation (24), simulation (29,037), nursing education and simulation (44), medical education and simulation (113). The Dissertation Abstract database was searched (1990 – March 2007) using critical thinking and nursing education keywords and resulted in 88 abstracts, and critical thinking, nursing education and simulation yielded 5 abstracts. The ERIC (1966-March 2007) database was queried using the keywords critical thinking and simulation (221), critical thinking and nursing education (114) and critical thinking and medical education (37). One thousand, four hundred thirty seven articles were reviewed for content and research focus. One hundred and forty two research references were found including 44 unpublished dissertations. Research studies focusing on the use of human patient simulation in nursing or medical education were used for this review of literature. Additionally, articles and research studies focusing on the use of problem-based learning to promote critical thinking skills were reviewed and included in this literature review. Books were reviewed to understand more fully the meaning of critical thinking in nursing. The Internet was searched for critical thinking and human patient simulation sites as a way of determining the ways in which simulation is used. The following section summarizes the relevant literature on the construct of critical thinking, the methods employed by nurse educators to teach critical thinking skills and the role patient simulation has taken in both nursing and medical education when teaching critical thinking.

Phenomenon of Interest

Socrates is often credited with being the first to teach critical thinking. He conducted lengthy discussions with his students regarding the beliefs they held. Questioning continued until he was able to change completely the convictions of his students, thus showing them that they really did not know what they thought they knew. This "Socratic" method of inquiry is often used in medical education and occasionally in other health-related fields, including nursing.

Other philosophers, scholars and teachers have developed definitions of critical thinking over the years. A few of these philosophers are referenced frequently in the literature and their theories of critical thinking are used as the basis for the formation of new or adapted definitions of critical thinking. One such person is John Dewey. He is often referred to in the literature as the philosopher who, at the beginning of the 20th century, brought the concept of critical thinking to the forefront. Dewey (1916) declared that critical thinking was a skill that all citizens should possess in order for the American economy to prosper and for democracy to be successful. Dewey (1916) defined critical thinking as a reflective process, in which individuals are active, persistent and careful in the considerations in which they engage. He believed that individuals should not only understand new information or elements of a situation, but must also understand the outcomes and implications of their beliefs and actions (Fisher, 2001). Dewey emphasized that it was necessary for an individual to suspend judgment until all aspects of the situation or concept were considered. He urged all individuals to question what they were being told, not take things at face value, but be skeptical until one could make a decision or form an opinion on one's own (Dewey, 1916). He particularly stressed the role of the educational system as being responsible for preparing its students with critical thinking skills so they could be prepared to work in an ever-changing world. Dewey was talking about the industrial revolution that was occurring at that time, but his ideas remain relevant during this time of exploding science and technology. The historical influence of Dewey in making educators think about critical thinking in their area set the stage for educators to teach critical thinking when developing scholarship in their discipline.

More recently, Ennis (1987), philosopher and educator, described critical thinking as reasonably reflective thinking focused on deciding what to believe or do. In this definition, Ennis implied that critical thinking was necessary when problem solving or during the decision-making process. Ennis described individuals as having dispositions to critical thinking, such as seeking reasons, trying to be well informed, using and mentioning credible sources, looking for alternatives, being open-minded, and remaining sensitive to the feelings, level of knowledge and degree of sophistication of others (Ennis). Ennis explained that individuals who possess these dispositions were prepared to evaluate statements and question what was being said and taught. Consistent with Dewey's earlier premises, Ennis described critical thinking as an active, reflective process of thinking. However, he argued that critical thinking was contextual, domain or subject specific (Ennis, 1990). Ennis postulated that background knowledge was necessary for making justified critical thinking judgments, that critical thinking was different from one discipline to another, and that in order to have a full understanding of a discipline, the ability to critically think in that discipline was necessary (Ennis, 1990).

The concepts of critical thinking were advanced by other philosophers, such as Paul, who described critical thinking as a process of thinking to a standard (Paul, 1990). Like Ennis, Paul placed critical thinking within the context of a specific domain or discipline. He argued that critical thinking was contextual and must be understood within the discipline that holds specific beliefs or concepts. Within that context, individuals must develop self-directed, critical thinking skills as they grapple with the specific content of the discipline. Therefore, critical thinking skills cannot be considered a separate set of skills, but part of the discipline itself (Paul, 1993).

Paul (1990) described three dimensions of critical thinking. The first dimension, Paul argued was the perfections of thought such as having clarity, precision and specificity. He warned that these perfections occur within a specific domain and cannot be generally applied to other disciplines. The second dimension included ten elements of thought. Within this multidimensional perspective of critical thinking, Paul (1990) postulated that the critical thinker must be able to formulate, analyze and assess the 1) problem or question at issue, 2) purpose or goal of thinking, 3) frame of reference or points of view involved, 4) assumptions made, 5) central concepts and ideas involved, 6) principles or theories used, 7) evidence, data, or reasons advanced, 8) interpretations and claims made, 9) inferences, reasoning, and lines of formulated thought, and 10) implications and consequences that follow (Paul, 1990). Paul (1990) suggested that educators could use these ten elements to determine whether a student in a particular discipline was able to discuss the logic or the fundamental goals of the discipline studied. In nursing education, it is the goal of the educational process to have the student not only learn the fundamental skills and knowledge of the subject, but also to be able to reason through a variety of situations in which the fundamentals must be adapted to be applied.

Lastly, Paul (1990) described the third dimension as seven interdependent traits of mind that educators should cultivate in students, including: 1) intellectual humility, 2) intellectual courage, 3) intellectual empathy, 4) intellectual good faith (integrity), 5) intellectual perseverance, 6) faith in reason, and 7) an intellectual sense of justice. These seven traits are not understood to be domain specific, but can be globally applied to all disciplines. Within Paul's theory of critical thinking are affective and cognitive skills that students must develop. If successful in developing strong critical thinking skills, Paul declared that students were prepared for a lifetime of thinking (Paul, 1990). Despite the works of Paul and other philosophers, educators accepted no clear definition of critical thinking. However, their influence on the future of critical thinking was later supported by the findings of the APA's Delphi Research Survey on critical thinking, as many of the same critical thinking skills and dispositions were identified.

Both Paul and Ennis proposed that there were affective and behavioral aspects of critical thinking that must be considered in addition to the cognitive processes involved. The affective aspect must be stimulated in order for the individual to begin thinking critically about a subject or situation. It is this affective aspect that activates the individual’s critical thinking behaviors. Once activated, the individual becomes engaged in critical thinking. But the aspect that students must develop is the cognitive aspect. Bloom, Englehart, Furst, Hill & Krathwohl (1956) were first to present the six levels of cognition, commonly referred to as *Bloom's Taxonomy*. This taxonomy includes the levels of knowledge, comprehension, application, analysis, synthesis and evaluation.

Bloom et al. postulated that these six levels were progressively more complex and mastery of the lower level had to be achieved before progressing to the next. The first four levels are clearly included within Paul's definition and explanation of critical thinking. Huitt (1998) postulated two ideas. First, he stated that there are two levels of cognition, of which analysis and evaluation are components of the second level. Second, he claimed that analysis and evaluation stand alone as independent aspects of thinking. Despite Huitts' assertions, and the supposed uncertainty of these two levels, educators from various disciplines have long included analysis and evaluation in their teachings of critical thinking. Bloom's Taxonomy has been embraced as foundational to curriculum and pedagogical theory and many educators attempt to include elements from all levels of the taxonomy in their teachings as a testimony to its value.

Likewise, Krathwohl’s affective domain describes behaviors learners demonstrate as they take knowledge and incorporate it into their repertoire of thinking. Krathwohl, Bloom & Masia (1964) describe five levels of behaviors, receiving, responding, valuing, organization and characterization by a value or value set that learners move through depending on where they are in their learning. Receiving refers to the student’s willingness to attend to the content while responding refers to active participation in the learning process. The third level is the amount of value a student attaches to the content being learned; organization involves students incorporating new information into their value set and the last behavior is the student embracing the content and reordering their value set to include the new information for future use (Krathwohl, 1964). Krathwohl’s affective domain behaviors are equally important as Bloom’s Taxonomy for the cognitive abilities. Although foundational to education, neither taxonomy is overtly evident in critical thinking definitions.

Garrison's (1992) work on critical thinking describes five stages that critical thinkers engage in as they work through situations. These stages are not necessarily linear, but may represent a coiling of stages, stepping back into a previous stage as new information and concepts are introduced to the thinker and then moving further along in the five stages as the thinking progresses. Garrison's five stages include problem identification when the learner experiences a triggering event that arouses curiosity, longing to determine more about the problem. This is followed by problem definition when the learner frames the problem and an approach to its solution using the experiences of others and themselves. Problem exploration involves the learner obtaining insight into the problem using inference, induction and deduction. Creative solutions to the problem are formulated, ideas are linked and assumptions made. Applicability and problem evaluation is the next step. In this stage, evaluating what has been accomplished to this point occurs. Decision-making is a large component of this stage including an evaluation of the progress and mistakes made, and determining what else needs to be done. The last stage is problem integration. In this final stage, strategies are grounded in the actual situation and modifications are made allowing for sustained change. New knowledge is integrated into the individuals' tool kit as well as the solution to the problem being found. Despite such in-depth formulation of critical thinking by some researchers, Nursing and other professions have been unable to embrace one definition of the concept of critical thinking. This led to efforts to develop a consensus definition of critical thinking.

The Delphi Research Project

The multidisciplinary Delphi Research project on critical thinking conducted by the APA (1990) provided a definition and list of critical thinker attributes. The consensus panel defined critical thinking as the process of purposeful, self-regulatory judgment involving an interactive, reflective and reasoning process (APA, 1990). Accordingly the ideal critical thinker possesses attributes such as being:

> "habitually inquisitive, well informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider former opinions, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit" (APA, 1990, p 3).

The descriptions of critical thinking and critical thinkers listed above describe the context in which critical thinking occurs; during the reasoning or decision-making process. Many disciplines including nursing have used different terms such as clinical judgment, problem solving, clinical reasoning, and decision making for the same concept of critical thinking, (APA, 1990). Throughout the nursing literature it appears the terms critical thinking, clinical judgment and decision-making are used interchangeably.

The importance of critical thinking was supported by the National Governors' Association in 1990, headed by Governor Bill Clinton of Arkansas that recommended that critical thinking be included in the national educational goals (Goals 2000, 1994).

Subsequently, the Bush administration, in 1990, adopted this educational reform goal statement (Goals 2000, 1994). In this statement, The United States Department of Education mandated the demonstration of a significant improvement in critical thinking in all of our nation's college graduates by the year 2000. Despite this mandate, specific guidelines were not provided for the inclusion of critical thinking in the curriculum, nor were directions for the evaluation of improvements in critical thinking specified. During the Clinton Administration the emphasis shifted to developing these two major areas, albeit unsuccessfully.

At about the same time that the Goals 2000 initiative was adopted, the National League for Nursing (National League for Nursing [NLN], 1991), an accrediting body for nursing education programs, mandated that all educational programs include content on critical thinking and assess the critical thinking of their nursing graduates. This initiative allowed the nursing profession to be an integral participant in shaping the criteria for evaluating theory on critical thinking and determining the assessment criteria to be used in its educational efforts. At that time, the NLN described critical thinking as a component of problem solving in which the problems are complex, novel, time-pressured, high stakes and widely diverse in context (NLN, 1990). This description of critical thinking included the nursing process, a foundational component of nursing education and the basis upon which clinical judgment is formed.

Since the NLN mandate and the publication of the APA Delphi Report, nurse educators have written numerous books and articles describing how critical thinking should be applied to the practice of nursing and taught in its curriculum (Alfaro-LeFevre, 1999; Pesut & Herman, 1999; Lowenstein & Bradshaw, 2001; Miller & Babcock, 1996;

Rubenfeld & Scheffer, 1995; Haskvitz & Koop, 2004; Paparella, Mariani, Layton & Carpenter, 2004; Henneman & Cunningham, 2005). Despite this, neither a unitary definition of critical thinking nor a consistent way of teaching critical thinking to nursing students has emerged. The following sections present various ways in which educators have included critical thinking concepts in nursing curricula and the research results obtained from studies conducted to determine its effectiveness.

Critical Thinking in Nursing

It is impossible for nursing educators to teach nurses how to handle every situation. Critical thinking is an important skill for nurses to possess because when faced with uncertain or novel experiences, nurses are expected to respond to the situation or issue appropriately. It is expected that nurses will be confronted by a growing number of situations requiring critical thinking skills, due to the dynamic changes occurring in health care. Additionally, the explosion of health care technology requires nurses to apply principles learned in nursing schools to new situations. Nurse educators agree that critical thinking skills are essential tools for practice. A discussion of how critical thinking is conceptualized and taught and how students develop critical thinking skills follows.

Shortly after the APA report was published in 1990, the National League for Nursing (NLN) (1991), the major accrediting body for academic nursing programs at that time, mandated that critical thinking content be included in all nursing curricula. However, a unitary definition of critical thinking in nursing had not been adopted. The NLN did not provide a definition of critical thinking, but the evaluation criteria described analysis, reasoning, research and decision-making skills resulting from thinking (NLN, 1991). Since the NLN mandate, nurse educators have written several books and articles conceptualizing how critical thinking could be applied to nursing and taught in the curriculum (Alfaro-LeFevre, 1999; Pesut & Herman, 1999; Lowenstein & Bradshaw, 2001; Miller & Babcock, 1996; Rubenfeld & Scheffer, 1995; Haskvitz & Koop, 2004; Paparella, Mariani, Layton & Carpenter, 2004; Henneman & Cunningham, 2005). Ways critical thinking has been defined by nurse educators are discussed in the following section.

Nurses' Definitions of Critical Thinking

The definition compiled by the Delphi researchers (APA, 1990) described critical thinking as the process of purposeful, self-regulatory judgment and an interactive, reflective, reasoning process. Thiele (1993) described the same elements in her description of clinical decision-making. Boostrom (1994) defined critical thinking as a way of looking at reasons for believing one thing rather than another in an open and flexible manner, while paying attention to details. Kyzer (1996) described critical thinking as a process of choosing, weighing alternatives and considering what to do next. All of these definitions clearly emphasize the concept of open-mindedness. Critical thinking is defined by some as the thought process underlying effective clinical problem solving and decision making (Oermann, 1997; Oermann & Gaberson, 1998; Oermann, Truesdell, & Ziolkowski, 2000), thus providing the contextual aspect to the definition. Wallace (1996) and Sedlak (1997) both added a reflective component to this definition. Miller and Babcock (1996) described critical thinking as purposeful thinking that takes into consideration focus, frame of reference or context, evidence, facts, attitudes, assumptions, reasoning, conclusions and implications, again emphasizing the context in which critical thinking occurs. Alfaro-LeFevre (1999) defined critical thinking as purposeful and goal directed thinking that uses the scientific method and its principles and is directed towards making judgments. This definition built on the already embraced approaches used by nurses, the nursing process. The five steps of the nursing process include assessing, identifying the problem or diagnosing, developing a plan, implementing the plan, and evaluating how well the plan worked.

All of these definitions suggest that critical thinking occurs within the context of problem solving or decision-making. They suggest that the critically thinking individual must remain flexible and open-minded while considering options and reflecting on the thinking that is being done. It is important to note that critical thinking is an active process directed towards making judgments or decisions.

Nurse educators often equate the nursing process with the scientific method. Nurses use the nursing process of assessment, interpretation, planning, implementation and evaluation of a problem as *the* method to use when attempting to solve a patient problem or issue. Many definitions liken critical thinking to clinical reasoning, clinical judgment and decision-making, while others argue that critical thinking is a component of a larger problem-solving process (Oermann, 1997; Oermann & Gaberson, 1998; Oermann, Truesdell, & Ziolkowski, 2000). Since the nursing profession does not embrace one definition, many nurse educators and scholars have used the characteristics of critical thinkers as a way of defining critical thinking itself (Watson-Glaser, 1964; Brooks & Shepherd, 1990; Facione, Facione & Sanchez, 1994; Facione & Facione, 1996; Kamin, O'Sullivan, Younger & Deterding, 2001).

The lack of clarity regarding the definition of critical thinking leads to the confusion found when determining the characteristics of critical thinkers. As mentioned earlier, the APA (1990) Delphi Report described the attributes of critical thinkers. Some nurse educators such as Facione, Facione & Sanchez (1994) incorporated these characteristics into their description of critical thinkers, whereas others used attributes such as possessing an attitude of inquiry and a frame of mind that recognizes problems, as described by Watson and Glaser (1964).

Facione (1990), the principle investigator of the Delphi study discussed earlier, developed a definition of critical thinking based on the results of the survey. This definition included not only dimensions of the skill of critical thinking, but also personal dispositions. The definition agreed upon is that critical thinking is a reasoned, purposive and introspective approach to solving problems or issues for which an incontrovertible solution is desired (Facione, 1990). The Delphi panel concluded that interpretation, analysis, evaluation, inference, explanation and self-regulation were fundamental aspects of critical thinking. Facione (1990) asserted that the person expected to think critically must have a disposition to do so. The Delphi study identified skills involved in critical thinking as well as dispositions. Facione (1990) described the disposition to critical thinking as the consistent, internal motivation to engage in problem solving and decision-making using critical thinking.

Based on the findings of the Delphi study, Facione and his colleagues created the California Critical Thinking Skills Test and California Critical Thinking Disposition Inventory (Facione, Facione & Sanchez, 1994). Three forms of the California Critical Thinking Skills Test (CCTST) exists; Form A, B and 2000. Each test is a 34-item, multiple-choice test that targets core critical thinking skills regarded to be essential in college education. Validity of the CCTST is broken down into three components: content validity, construct validity and criterion validity. Content validity refers to how well the specific test items represent the universe of possible test items within a specified domain, in this case, critical thinking (Facione, Facione, Blohm & Giancarlo, 2002). Each of the items included in the CCTST were chosen based on its theoretical relationship to the Delphi Reports' conceptualization of critical thinking (Facione, et al., 2002). The items chosen for inclusion into the CCTST cover the five areas of cognitive skills identified by the Delphi experts. These areas are interpretation, analysis, evaluation, explanation and inference; areas that are discipline neutral. Construct validity refers to the extent to which the test measures what it says it does, in this case the ability to measure the Delphi panel's conceptualization of critical thinking. Testing by the authors has been done with large populations of students and the CCTST has been found to have high construct validity. The last type of validity is criterion validity. Criterion validity refers to the test's ability to be predictive of some external criterion, does the CCTST score have a high correlation with some gauge of school success (Facione et al.). Validity of the CCTST is reported to be .74 and has been shown to have moderate criterion validity with both grade point average and scholastic aptitude test (SAT) scores.

The internal consistency (reliability), as estimated by the Kuder-Richardson 20 is .68 to .70. Reliability scores traditionally accepted are above .80, for tools evaluating a single concept. The CCTST evaluates five sub-areas of critical thinking and therefore, a KR-20 score of .68-.70 is acceptable (Facione, et al., 2002)

The California Critical Thinking Disposition Inventory (CCTDI) is a 74-item instrument that measures the personality attributes of students. The attributes of inquisitiveness, being systematic, analytical, truth seeking, open-minded, having critical thinking self-confidence and maturity are measured. The Cronbach's alpha for internal consistency is .90 for this tool, while sub-area reliability is similar to the CCTST in measuring critical thinking abilities of student nurses (Facione et al., 2001). The content, construct and criterion validity of the CCTDI are described to be the same as the CCTST, since this test's construction was similarly based on the results of the Delphi study. However, the sample size used to establish the validity of this tool was only 20 and therefore its validity is questionable.

The CCTST, CCTDI and other tools have been used to evaluate the critical thinking ability of college students. Research to determine the effectiveness of these approaches in nursing education studies has been inconclusive and sporadic. A discussion of the research conducted to measure the critical thinking abilities of nursing students follows.

Critical Thinking Research

Several researchers have attempted to determine the level of critical thinking of students in varying levels of nursing programs. A few have used analysis of journal writings to determine whether students have used critical thinking skills in their learning exercises. For example, Sedlak (1997) set out to determine if nursing students enrolled in the first clinical course of their baccalaureate program thought critically after content on critical thinking was included in their curriculum. Critical thinking, in this study, was defined as a reasoning process in which individuals reflected on the ideas, actions and decisions of ones' self and others related to the clinical experiences in which they participated. Students (n=7) completed a weekly journal reflecting on the decision-making they had done, and participated in three interviews throughout the semester and were observed in the fundamentals laboratory (Sedlak, 1997). Qualitative analysis according to emerging themes showed that this small group of beginning nursing students thought critically (Sedlak, 1997). In addition, the use of reflective writing enhanced the individuals' metacognition and their perspectives on thinking changed over time.

In a study conducted by Wallace (1996), 50 nurses participated in an in-depth reflective interviews using a modified critical incident technique regarding their nursing practice; thus requiring metacognition. Critical thinking in this study was defined as being appropriately moved by reasons and added that reflection was necessary to foster critical thinking. The data obtained implied that critical thinking occurred when nurses deviated from their usual or expected practice.

Burman, Stepans, Jansa & Steiner (2002) conducted an examination of advanced practice nurses, specifically primary care nurse practitioners. Since many definitions of critical thinking include skill in clinical decision-making, the decision making process of primary care nurse practitioners (n=36) was examined through a grounded theory qualitative approach. The critical thinking theory tested in this study was the pattern-matching model in which various heuristics were used to simplify decision-making. This study's methodology included in-depth interviews in which participants were asked to find solutions to two separate, patient-focused vignettes during audiotaped interviews. Through analysis and coding of narratives, researchers determined that clinical decision-making required an iterative process of gathering data and making inferences from the information. The experiential context of participants was shown to play a large role in the way they approached the problem, another element of several of the definitions of critical thinking. These results suggest that a problem-solving strategy alone was not enough, but should be augmented by stressing the need of attending to salient aspects of the situation.

Including opportunities for metacognition or reflection during the problem solving or reasoning process, as presented in this section, appears to have a positive effect on the critical thinking abilities of nursing students. Still it is not known how much critical thinking occurs, and whether the amount of critical thinking ability a student possesses at one point in a nursing program changes over time. The next section presents quantitative research studies examining whether a change in critical thinking ability of students occurs after critical thinking exercises are included in the curriculum.

Does Critical Thinking Ability Change Over Time?

One assessment test developed to measure the amount of critical thinking a person possesses is the Watson-Glaser Critical Thinking Assessment Test (WGCTA), a quantitative instrument examining the reasoning ability to measure critical thinking. This tool is not specific to nursing; however, it has been used several times by nurse researchers attempting to measure critical thinking (Watson & Glaser, 1980).

The WGCTA is available in Forms A and S. Form S is a shorter version of Form A and consists of a 40-item test that can be given either timed or not. The construct validity of the tool is based on Form A and is suggested to be high but no specific values are provided for either version. The WGCTA measures five sub-areas of inference, recognition of assumptions, deduction, interpretation and evaluation of arguments. The Cronbach's alpha for internal consistency reliability is described to be approximately 0.76. It is recommended that the sub areas measured by the WGCTA be considered in their entirety and not used as individual measures. Despite not having a clear understanding of the construct, content or criterion validity, several researchers have used the WGCTA attempting to measure critical thinking (Watson & Glaser, 1980).

Brooks & Shepherd (1990) administered the Watson-Glaser Critical Thinking Assessment (WGCTA) and the Nursing Performance Simulation Instrument (NPSI) to 50 students from all four levels of nursing programs (n=200); two-year associate degree, three-year hospital-based diploma, upper level (2-year) Registered Nurse (RN) return program students (with a minimum of 3 years of practice) and the four-year baccalaureate program students. Their purpose was to determine which of the four nursing education programs had the higher mean scores on tests measuring clinical decision-making and critical thinking abilities in nursing. This cross-sectional study found mean scores of participants in both the upper-level and baccalaureate programs to be significantly greater ($p<.05$) than the associate and diploma student mean scores. No statistically significant difference was demonstrated between the upper-level and baccalaureate students or the associate and the diploma students. When the scores on the NPSI were analyzed, the upper-level students, compared to all other groups, scored significantly higher ($p<0.05$). The upper-level students had previous nursing experience (minimum of 3 years of practice) before returning to school. It could be hypothesized that previous opportunities to practice nursing may improve critical thinking abilities of nursing students, however not all students have previous nursing experience. Therefore, studies continued to be conducted to determine whether nursing programs' curricula had an effect on the critical thinking abilities of their students.

Notarianni (1991) conducted a 2-year, longitudinal quasi-experimental study to determine the gains in critical thinking of nursing students during one year of their basic nursing education program. Associate degree students were given the WGCTA at the beginning and end of the first and second years of their programs. The baccalaureate-nursing students were given the assessment at the beginning and end of each of the four years. The researchers found both the baccalaureate and associate degree students had a statistically significant drop in critical thinking scores in their second year when compared to their first year scores ($p < .001$). There was no significantly positive change from pre-test to post-test WGCTA scores for any of the four years of the baccalaureate degree program or for the two years of the associate degree program. It is unclear why this drop in critical thinking occurred. The authors postulated that it could be due to the insensitivity of the WGCTA tool to detect small changes. Another possible reason for the decrease in scores could be that the critical thinking construct for nurses is not measured by this tool. Nonetheless, these results were similar to those found in earlier studies.

Medical educators have also attempted to demonstrate a change in critical thinking abilities of their students as they progress through medical school (Scott, Markett & Dunn, 1998). Students ($n=82$) completed the WGCTA at the beginning of the first year of medical school and again near the end of the third year. During the third year of medical school, students' performance in clinical clerkships was evaluated. These scores were correlated with the scores obtained by students on the WGCTA. The improvement in total scores from the first year when compared to the third year was statistically significant ($p<.026$). Total scores for women and men from the first year compared to the third year increased, but not statistically significantly. These results revealed that critical thinking abilities of medical students improved during the first three years of medical school. This improvement may be due to an increased knowledge base in medicine, a clearer understanding of the way medical personnel make decisions and think about patient-related issues, and through exposure to an academic environment that promoted higher-level thinking and reflection (Scott, Markert & Dunn, 1998).

In a similar study, the WGCTA was administered to baccalaureate students at four junctures in a nursing program, through a repeated measures design to determine if gains in critical thinking occurred during the nursing program (L'Eplattenier, 2001). Students were tested at entry, mid junior year, beginning of senior year and program exit (n=83). Sixty students already enrolled in classes were included in the study but not pre-tested. Twenty-three students were tested at all four junctures. No significant difference was found in the critical thinking of students from one point of testing to the other; however, a positive trend in scores was reported. Similar results were obtained in an earlier study conducted by Nathan (1997) examining the change in academic performance and WGCTA scores of nursing students over the course of one year. No relationship was found between grade point average (GPA) and WGCTA scores, or the WGCTA scores from the beginning of the year to the end of the year, however, the group demonstrated an increase in numerical GPA.

In a cross-sectional and longitudinal research study conducted by Frye, Alfred & Campbell (1999), critical thinking abilities of baccalaureate nursing students at the freshman and senior level (n=132 freshman, n=77 senior) were compared, using the WGCTA tool, to determine if a change in critical thinking occurred as a result of nursing education. A significant positive difference in the composite scores of freshman compared to the composite scores of seniors was found in the cross-sectional arm of the study ($p<.05$). However, in the longitudinal arm of the study, students who were tested as freshman and again as seniors ($n=27$) were found to have no statistical difference in scores. It is unclear why changes over time are not reflected in the longitudinal arm scores, when positive differences in composite scores in the cross-sectional arm were found to be statistically significant.

Confounding variables such as the maturing of students, life experiences not associated with nursing, motivation of students in the study and the varying manner in which critical thinking is taught were considered by the researchers as possible reasons for the varied results of these studies. In their analysis of findings, Frye, Alfred & Campbell (1999) questioned the sensitivity of the WGCTA tool to detect small changes in critical thinking. This is understandable since 33 of the 40 items on Form S provide only two choices in a multiple-choice format (Watson & Glaser, 1964). In his review of Form S of the WGCTA, Geisinger (1994) questioned the validity of the tool due to its narrow norm grouping over only 15 score points. The ability of the tool to measure the specific critical thinking abilities of nursing students has also been questioned. The manual cites uses for employment-related training such as management, sales, and marketing, but none specific to nursing (Watson & Glaser, 1964).

The results presented in this section show a trend towards improvement of critical thinking abilities from participation in nursing and medical education programs. These trends may be due in part to the students becoming familiar with the domain of knowledge of their respective disciplines. Additionally, students learned how nurses and physicians think about the situations in which they are confronted. Hence, it can be postulated that there are contextual and experiential aspects to critical thinking.

Other tools used to measure critical thinking in nursing are available. The California Critical Thinking Skills Test (CCTST) and the California Critical Thinking Disposition Inventory (CCTDI) both described earlier are two such tools. These tools were developed to measure critical thinking of college students. These two tests, developed by Facione & Facione (1992) are based on the critical thinking definition and list of critical thinker attributes identified by the Delphi Research Report published by the APA (1990).

In 1999, May, Edell & Butell described the correlation between critical thinking and clinical competency of senior baccalaureate nursing students (n=143). Through a mixed methods design, the researchers administered the CCTST and the CCTDI to students and a demographic data form. The results of the assessments were correlated using the Pearson product-moment correlation. Little relationship between critical thinking and clinical competence scores was found in this study. Although, from a descriptive statistics perspective, the researchers were able to confirm that the CCTST and the CCTDI tested inter-rater reliability scores of .81, as reported by Facione, Facione & Sanchez (1994).

Bowles (2000) evaluated the relationship of critical thinking to clinical judgment abilities in baccalaureate nursing students at the completion of their program and correlated the scores with the age, years in college and cumulative grade point average of the participants. The California Critical Thinking Skills Inventory (CCTSI) Form A was administered to participants (n=65) to evaluate their critical thinking abilities and the Clinical Decision-Making in Nursing Scale (CDMNS) was used to evaluate clinical judgment (Bowles, 2000). Results indicated a significantly positive relationship between critical thinking and clinical judgment ($p<0.05$). Analysis of the sub scale scores revealed that inductive reasoning and inference were found to be significant predictors of clinical judgment ($p<.05$). Bowles (2000) was the first researcher to demonstrate a statistically significant correlation between critical thinking and clinical judgment in nursing students.

Similarly, Pitts (2001) tried to correlate the scores of associate degree nursing students (n=277) on the CCTST and/or the CCTDI to gender, GPA, age, and ethnicity. No significant correlations were found between the scores obtained on either the CCTDI or CCTST and any measured variable. The reasons for these results are unclear, but the author suggested that the tools used did not detect small changes in critical thinking (Pitts, 2001).

In a comparison study between community college level students (in a pre-nursing program) and baccalaureate level students in a collaborative nursing program (where students move from the pre-nursing program into the baccalaureate program), Johnson (2002) attempted to determine whether a positive change in critical thinking ability occurred as students progressed from one level to the next. A pre-test/post-test design was used in which the CCTST was administered at the beginning and end of both the associate degree level and the baccalaureate level for the same students (n=37) as they progressed from one level to the next. Statistically significant increases in post-test scores when compared to pre-test scores were found as students progressed from the associate degree level through the baccalaureate level ($p< .05$). The results of this study support the findings of Bowles (2000) presented earlier and demonstrate that students progressing into the third and fourth year of their baccalaureate program have positive increases in critical thinking scores.

The studies presented in this section have demonstrated positive changes in critical thinking levels of nursing students as they progress through their educational programs. These findings are consistent with Paul's (1990) theory regarding critical thinking arguing that as one's knowledge increased in a particular discipline and the individual became more aware of the context in which critical thinking is conducted, ones' critical thinking improved. Of note is that none of these studies discussed the instructional method or methods used in the nursing program that may have positively affected the students' critical thinking. They have only shown that critical thinking improves as the student’s progress through the program. There could be several reasons for this improvement, such as the students maturing; the types of experience students have while attending a nursing program and numerous other reasons.

The literature describing the use of the CCTST and CCTDI tended to show more positive results than those using the WGCTA, however, the results are not so impressive that one measure should be chosen over another. This could be attributed to the study methods used by the researchers. Most of the researchers used convenience samples of nursing students, arbitrarily measuring the level of critical thinking at the time the study was initiated and then repeating the measure at some designated time in the future. Numerous confounding and intervening variables, such as student’s involvement in extracurricular activities, maturing of participants over time, and students taking other courses that may also include critical thinking content, could possibly have affected changes in critical thinking. In addition, no clearly defined method of teaching critical thinking in the nursing curriculum was described or suggested in any of the studies presented. The researchers chose to measure the critical thinking abilities of student nurses without specifying a particular curricular method of teaching critical thinking. Therefore, the utility of these study results is questioned.

The manner in which the researchers selected the critical thinking assessment tool they used is not well described in any of the studies. Most of the research articles presented a review of the literature describing a particular perspective on critical thinking that led the author to use one of the tools, either the WGCTA or the CCTST. Although these tools have been used in several studies, neither tool has been shown more definitively to measure critical thinking than the other does. Explanations for this could be that the tools are not sensitive enough to measure small differences in critical thinking, that they do not actually measure the critical thinking that nursing students actually do or that the curricular methods used to teach critical thinking were not significantly effective. In 2000, Bowles asserted that there is a need for more research examining curriculum that further augments the development of critical thinking and clinical judgment skills. One such method that is frequently described in the literature is the use of problem-based learning. This approach to teaching critical thinking uses clinical situation analysis and problem solving. A discussion of several research studies that have examined the effects of using problem-based learning as a method of teaching critical thinking follows.

Critical Thinking via Problem-based Learning

The nursing literature is rich with accounts of problem-based learning approaches to teaching critical thinking skills (Pond, Bradshaw & Turner, 1991; Weiss & Guyton-Simmons, 1998; Rendas, Rosado-Pinto & Gamboa, 1999; Magnussen, Ishida & Itano, 2000; DeMarco, Hayward & Lynch, 2002). The problem-based learning approach uses in-class discussions of situations encountered in clinical practice. The discussion focuses on exploring the answers to how these situations could or should be handled. Students search their knowledge base and apply principles they have learned to the situations presented in class. The instructor role models the critical thinking and decision-making required to come to a solution (Girot, 1995). Students sometimes work within groups to solve problems, thereby promoting collaboration with others and allowing for socialization of the student as a colleague and professional. Problem-based learning is thought to provide students with the opportunity to observe how others think through a particular situation and to promote students' self-directed learning through self-assessment (DeMarco, Hayward & Lynch, 2002). Nursing writers have used the terms problem-based learning, case study analysis, and inquiry-based learning interchangeably.

The problem-based learning approach to teaching critical thinking has the benefit of having students engaged in an active learning environment. Students are asked to participate in the discussion, to consider alternatives to others' answers and to apply previous experiences to new situations. In a study conducted by DeMarco, Hayward & Lynch (2002), students were asked to complete a questionnaire after completing their problem-based learning experience. Based on an analysis of the questionnaire responses, it was found that students determined the situation to be realistic and relevant to their learning, had increased enthusiasm and were more apt to complete the project (DeMarco, Hayward & Lynch, 2002). However, limitations were identified in this test of problem-based learning. Some respondents reported a desire for better -defined learning objectives, more formal teaching of concepts and a dislike of the lack of structure that problem-based learning discussions encouraged (DeMarco, Hayward & Lynch, 2002). Despite the positive results found in this study and the numerous accounts of problem-based learning approaches to teaching critical thinking, few research studies are reported in the literature. The following is an analysis of the studies discovered.

The effect of the problem-based learning approach used throughout the course of a four-year baccalaureate, nursing program was studied by Magnussen, Ishida & Itano (2000). These researchers administered the Watson-Glaser Critical Thinking Appraisal (WGCTA) Form A to the students (n=228) upon entry into the program and the WGCTA Form S in the last semester of their nursing program (n=257). Data analysis revealed no statistical difference between entry and graduation scores. However, when the scores were stratified between low, medium and high pre-test to post-test scores, it was found that those who scored lowest on the pre-test had a significant improvement in their post-program scores ($p<.01$), demonstrating that critical thinking was developed in these students over the course of the program. The researchers questioned the sensitivity of the WGCTA to smaller changes in critical thinking and the motivation of the graduating participants to do well when completing the assessment.

The Clinical Expertise in Critical Care Nursing study found classroom discussion approaches to teaching clinical judgment typically focus on reasoning through formal case studies using defined criteria (Benner, Tanner & Chesla, 1992, 1995). This approach to reasoning, again using the problem-based learning, limits the ability of students to react to ambiguities, risks and ethical challenges that are often present in the clinical setting. Benner, Stannard & Hooper (1996) incorporated what they termed the “Thinking-in-Action” approach to teaching clinical judgment. This approach was designed to closely simulate the clinical reasoning and critical thinking needed by nurses in situations as they unfold, simulating a more realistic clinical situation. In the classroom, the researchers attempted to recreate the sense of risk, threat and opportunity experienced by the practicing nurse as a guide to problem identification and to aid in the development of memory and a sense of salience. Although the "Thinking-in-Action" approach was used with undergraduate students, it has potential for use with APN students, as this type of experience more closely simulates the real clinical situations of APN practice.

The "Thinking-in-Action" approach attempts to provide a classroom environment that simulates a real patient care setting. Although the authors described their reasons for creating such an environment, the pedagogical basis for this was not included. The multi-sensory, emotional and social environment characterized by Benner, Stannard & Hooper (1996) in the "Thinking-in-Action" approach is reflective of the generic influences on learning identified by Reisman and Kauffman (1980).

Generic Influences on Learning

When problem-based learning occurs in the classroom setting, the student is asked to use a fair amount of imagination in order to be fully engaged in the discussion. From a pedagogical standpoint, it may be more beneficial to move this type of approach into an environment in which multi-sensory, social and emotional stimuli are present. In an early work, Reisman and Kauffman (1980) proposed a list of generic factors that influence learning. These generic factors were categorized into four subsets: cognitive, psychomotor, physical and sensory and social and emotional (Reisman & Kauffman, 1980). These researchers recommended that educators consider these factors as they develop their teaching plan and create the learning environment with the objective of creating an optimal environment for learning to occur.

Cognitive Influences on Learning

The cognitive influences on learning, described by Reisman & Kauffman (1980), refer to the ability of the student to: a) attend to the salient aspects of a situation, b) form relationships, concepts and generalizations from the content learned, c) retain information, d) be provided with repetition to achieve mastery, e) use problem-solving strategies, f) draw inferences and conclusions and to hypothesize, and g) abstract and cope with complexity. Advanced Practice Nursing students are expected to achieve mastery of advanced assessment and evaluation skills, complex pathophysiological concepts and disease management approaches in a short time frame and to be able to apply these principles to a multitude of clinical situations that will arise in their practice. The learning environment provides students with the opportunity to apply concepts learned and facilitates the development of both students' confidence in what they have learned and in their ability to think critically about the scenario.

Psychomotor Influences on Learning

The psychomotor influences on learning address how students' understanding of the world develops through both the visual and auditory experience (Reisman & Kauffman, 1980). Advanced Practice Nurses take what is learned in the classroom and apply it to the clinical setting. The classroom lacks the visual and auditory cues present in an actual clinical setting, cues that may assist the APNs' perception of the patients' response to illness and treatment. A learning environment offering visual and auditory cues should enhance the learning of students.

Physical and Sensory Generic Influences on Learning

Physical and sensory limitations that students may possess, such as acute or chronic disease states, low vitality and fatigue and such sensory limitations as blindness can affect the way learning occurs (Reisman & Kauffman, 1980). It can be argued that learning which occurs in a physical and sensory deprived environment influences the students' learning in much the same way as learning is limited if students have physical and/or sensory limitations. The educator who is aware of the limitations that a sensory deprived environment offers can make changes to the learning environment to overcome them, thereby improving the experience for the learners.

Emotional and Social Influences on Learning

The emotional and social influences on learning such as feelings of fear, anxiety, frustration, sadness and happiness affect the ability of the student to learn (Reisman & Kauffman, 1980). Emotions can either enhance or stifle learning. The educator can capitalize on the positive feelings of a learning situation by building on the enthusiasm that it creates. Teachers can recall situations to their students and may be able to recreate the same emotional responses when recalling new situations. When negative emotions occur during a learning experience the teacher must be prepared to recognize them and determine whether the feelings should be addressed in some manner. Furthermore, the educator should evaluate the type of learning environment used and determine whether a change is dictated. Many times a teacher can help students recognize the presence of negative feelings and find a way for students to deal with their emotions or change their response to the situation. Oftentimes emotions arise during learning due to the students' perception of their learning experience relative to their peers (Reisman & Kauffman, 1980). The teacher role models behaviors students should adopt while facilitating the development of their ability to respond to environmental, emotional and social cues present in a situation.

Application of Generic Influences to APN Education

Advanced Practice Nurses students are taught to think critically and make decisions affecting the health and well-being of people. It is important for nurse educators to create an environment for learning taking into consideration the four sub categories of generic influences. By doing so educators provide an environment that is student centered and focused on building students' strengths and not on their weaknesses, a pedagogically strong approach (Reisman & Kauffman, 1980).

A simulation laboratory, with an interactive, human mannequin that exhibits patient symptoms and in which the environment looks, sounds, and feels like the actual environment in which patient care occurs, may be the optimal environment for learning. The simulation laboratory provides an environment in which Reisman & Kauffman's (1980) four generic influences on learning are optimally integrated into the learning environment. Types of simulation and way it can be used to enhance learning are discussed in more detail.

Simulations and Their Uses

A simulator replicates a task environment with sufficient realism to serve a desired purpose (Bushell & Gaba, 2002). The simulation of critical events has been used by pilots, astronauts, the military and nuclear power plant personnel, a setting in which little room for error exists (Ressler, Armstrong & Forsythe, 1999). Simulation is however, newer to the medical profession but growing in its use and popularity (Issenberg et al., 1999). Recently, nursing literature has described the using full-sized, patient simulators as a way of creating “life-like” clinical situations (Fletcher, 1995; Monti, Wren, Haas, & Lupien, 1998; Bryans & McIntosh, 2000; Fallacaro & Crosby, 2000; Nehring, Ellise, & Lashley, 2001; Hotchkiss & Mendoza, 2001; Vandrey & Whitman, 2001; Nelson, 2003; Scherer, Bruce, Graves & Erdley, 2003; Hravnak, Tuite & Baldisseri, 2005; Long, 2005; Bearnson & Wiker, 2005; Parr & Sweeney, 2006).

Many advantages to using simulation are reported in the literature. Some of these include: a) presentation of uncommon critical scenarios in which rapid responses are required; b) participation in situations in which errors are allowed to reach their conclusion and students are allowed to see the results of their mistakes; c) encouragement of multidisciplinary team approaches to the management of patient problems; and d) development of procedural skills without risk to patients (Morgan, Cleave-Hogg, DeSousa, & Tarshis, 2003). Although these advantages support the use of simulation, some say there are disadvantages.

A few disadvantages to using high-fidelity human simulation have been identified in the literature. The most frequently mentioned disadvantage is the heightened sense of awareness by participants of the possibility for an untoward clinical event to be simulated in the learning session (Seropian, 2003). Another disadvantage is that some participants have difficulty suspending their disbelief during the session and therefore do not respond as honestly to the simulated situation as they might in an actual situation (DeMarco, Hayward & Lynch, 2002). Similarly, it is difficult to simulate improved patient outcomes accurately since in real patient situations, numerous confounding factors are present, that are not present in the simulation (Ashish, Bradford, & Bates, 2001).

One of the greatest barriers to using high-fidelity human simulation discussed in the literature is the cost of the simulators and the simulation centers built to house them. Costs range from $20,000 for medium-fidelity human simulation models to $200,000 for a high-fidelity simulator (Ashish, Bradford, & Bates, 2001). If a simulation center is created, the cost can be as great as a $1,000,000 depending on the amount of equipment included. For most schools of nursing, the cost prohibits the ability to deliver such experiences.

Simulation and Critical Thinking in Nursing

The simulations most often described in the nursing literature are computer adaptive, standardized (live) patients and the human patient simulators. In all of these simulations, an attempt is made to provide the multisensory, emotional and social environment promoted by Reisman & Kauffman (1980). The following section presents the relevant research studies for computer adaptive simulation.

Computer Adaptive Simulation

Many early accounts of simulation use in nursing education are found describing the use of computer adaptive/interactive simulation programs (Ravert, 2002; Goolsby, 2001; Chu, 1998; Madorin & Iwasiw, 1999; Weiss & Guyton-Simmons, 1998; Merril & Barker, 1996; Cohen & Dacanay, 1994; Lantier, 1992; Yuill, 1992; Sylvia, 1989). For example, Weiss & Guyton-Simmons (1998) examined the effect of computer simulation on critical thinking skills of associate degree nursing students in their last semester. Twelve of the fourteen students in their sample had difficulty making decisions from the data presented in the computer-based scenario. The two students who did well had previous licensed practical nursing (LPN) experience. From interviews conducted with participants, it was determined that simulation made the students think, use prioritization skills and participants described the situation as more realistic (Weiss & Guyton-Simmons, 1998). The fact that students with experience performed better should be noted, but its significance is unclear at this point.

Standardized Patient Simulations

In 2000, Bryans & McIntosh examined the use of simulation as an assessment of the nursing knowledge used in performing a community assessment. The advanced practice nurse students participated in two 20-minute simulation assessments of an actress-patient followed by a 45-minute structured interview conducted immediately after the simulation. The students reported finding the simulation contrived as they were allowed to assess the patient only once. However, the researchers determined that the simulation had the potential for exploring various aspects of knowledge involved in community nursing assessment practice.

In a similar study of both adult and pediatric nurse practitioner students, Vessey & Huss (2002) conducted a retrospective descriptive study of nurse practitioner students who had been videotaped during their performance of a simulated clinical encounter with a standardized (live) patient (SP). In this study, participants were given 30 minutes to develop a plan of care. All SPs had the same complaints and diagnosis. The videotapes were evaluated by experienced nurse practitioners who completed a comprehensive checklist of pre-determined criteria such as clarification of the chief complaint, history of present illness obtained, past medical and family history and review of symptoms. Twenty-two out of the twenty-six students included the correct diagnosis in their list of differential diagnoses. The researchers concluded that the SP encounter offered an interactive, educational experience. Those students requiring remedial work and those progressing appropriately could also be determined through review of the student performance videotapes, which from an educator's viewpoint are useful things to know.

The reported use of computer adaptive simulations and standardized patients is abundant in the medical literature. However, the ways in which these types of simulations are used in nursing education remains unclear. This is due in part to the scarcity of nursing research examining their effect. If more research were done in these areas, empirically based suggestions could be made. Nurse educators have described using human patient simulation along with problem-based learning as a method of teaching critical thinking. The research in this area follows.

Interface between Problem-based Learning and Simulation

The use of the human patient simulator in nursing education allows for the application of problem-based learning approaches in a multi-sensory, social and emotional environment thus providing students the opportunity to practice applying concepts, to think critically and make decisions about the simulated clinical scenario without causing harm to patients. Simulations place students in life-like situations that provide immediate feedback about questions, decisions and actions (Issenberg et al., 1999). Since simulations can be replicated, students are provided with the opportunity to change their responses to the scenarios and are allowed to consider the outcomes of their responses. If the instructor decides there is an important point to make in the middle of a session, the scenario can be paused and restarted after the discussion.

Patient simulators have the capability to repeat specific scenarios for training purposes, allowing for smaller groups of students to work with the simulators for greater involvement. Human patient simulations allow for repetition of skills, use of critical thinking skills and a decision-making venue, all without causing harm to real patients. Human patient simulators can be “killed” repeatedly without doing any real harm.

Pilots, astronauts, military and nuclear power plant personnel (Ressler, Armstrong & Forsythe, 1999), have used simulation of critical events. However, it is newer to the health professions but is growing in use and popularity (Issenberg et al., 1999). Since advanced nursing practice bridges both nursing and medical practice, it is reasonable to examine how medical educators teach their students to improve their critical thinking abilities and determine applications for nursing education.

Simulation in Medical Education

The effect of enhanced training in the diagnosis and management of crises on the development and maintenance of expert practice in anesthesiology was examined by Howard, Gaba, Fish, Yang & Sarnquist (1992). On the second day of this course, participants completed simulator sessions involving crisis management scenarios followed by a complete debriefing. There was a post-course questionnaire and a test and a post-post questionnaire was completed two months after participation. The researchers scored the tests and analyzed the data from the questionnaires. All of the simulated sessions improved participants' performance on the post-course test. The questionnaire asked the participants to rate the enjoyment, intensity and helpfulness of the sessions using a Likert scale. The scores from all of the sessions were 4.0 and above. A score of 1 represented the responses: did not enjoy, was not intense and was not helpful whereas a score of 5 represented participants: enjoyed the sessions, found them intense and helpful. These results reveal that participants in simulated scenarios can find the sessions enjoyable and helpful while still deeming them intense.

Similarly, Hill, Stalley, Pennington, Besser, & McCarthy (1997) developed a trauma care teaching intervention (SCORPIO) that required participants to attend six sessions over the course of two years that focused on trauma issues. The control group did not participate in any of the six SCORPIO sessions. At the completion of the 2-year period, participants were asked to complete 30 simulated stations; 8 of which were trauma-focused. The results revealed that participants of the SCORPIO program performed significantly better ($p<0.0005$) in the eight trauma stations as compared to the control group. There were no between-group differences in performance in the non-trauma stations. These results show that participation in simulated situations enhances performance of participants in future situations.

In 1998 Ali, Cohen, Gana & Al-Bedah studied the differences in performance of senior medical students in an Adult Trauma Life Support (ATLS) course. This course uses simulated scenarios to both teach and evaluate students' performance in trauma situations. The students were divided into three groups; 32 medical students completed a standard ATLS course, 12 students audited the course (without participating in the sessions or taking the written exam) and a control group of 44 matched students who had no exposure to ATLS. Of note is that some participants from all three groups were doing clinical hours in trauma hospitals during this study while others were not. The participants were observed while managing the standardized (live) patient in simulated trauma and non-trauma scenarios. The participants' management of the sessions was scored on a standardized checklist of 30 to 40 items with weighted scores for each. The results revealed that students trained in ATLS programs that used simulated scenarios, achieved the highest scores, while the students who audited the sessions for the ATLS scored lower. However, those who had no ATLS training scored the lowest for trauma-related scenarios. Performance in the non-trauma related scenarios were similar for the three student groups. The effect of students doing clinical hours in hospitals of varying trauma focus on the results was not discussed. This study is significant because many nurses are required to take ATLS and related simulation-based training sessions and this study demonstrated that participant performance improved after completing the training sessions.

The positive effects of using simulation were further supported by Marshall et al. (2001) when they examined the impact of a human patient simulator (HPS) and completion of an Advanced Trauma Life Support (ATLS) course, on the development of trauma management skills and self-confidence in surgical interns. In this study twelve surgical interns participated in two pre-ATLS course simulation scenarios, they then completed an ATLS course and then participated in post-ATLS scenarios. The interns were rated on performance in three areas: critical treatment decisions, potential for adverse outcomes and team behavior. The study revealed that participants' critical treatment decision (CTD) performance scores rose significantly ($p<0.002$), their potential for adverse outcomes (PAO) performance decreased significantly ($p<0.001$), and their team behavior (TB) scores increased significantly ($p<0.001$) after the ATLS/HPS course was completed (Marshall et al., 2000). These results provide strong support for the use of simulation in educational programs in which students' performance in high-risk situations will cause harm if not performed appropriately.

Additionally, these students completed pre and post-study self-confidence surveys meant to examine the students' level of self-confidence in their ability to perform appropriately in trauma-related situations. After the ATLS/HPS course, self-confidence increased significantly ($p<.01$) as compared to pre-simulation scores (Marshall et al., 2000). If these results could be replicated in non-study situations, then simulation used as an instructional augmentation will be invaluable.

Comparable results were obtained in a study conducted by Nadel et al. (2000). These researchers set out to examine the effects of an educational intervention of completion of a standardized examination, a technical skills workshop and a survey, on 3rd year pediatric residents' resuscitation fund of knowledge, technical skills, confidence and overall performance. The participants completed the Pediatric Advanced Life Support (PALS) examination plus 12 questions developed by the researchers and further clarified through peer review. Next, the same researcher, during a staged performance of four advanced life procedures observed each student. After that stage was completed, students were required to complete anonymous self-confidence and experience surveys (Nadel et al., 2000).

The results revealed that students' performance on the PALS examination, a course and examination they are required to complete in their first and third year of residency, was high, revealing a mean score of 93.2 %, as compared to obtaining a mean score of 60 % on 12 questions added to the exam (Nadel et al., 2000). On technical skills, successful performance of selected critical elements varied between scores of 100 % to 32 %. It was determined that 78 % of the participants demonstrated errors in endotracheal intubation technique, which could result in unsuccessful airway intubation. Interestingly, the results of the self-confidence surveys revealed that 74 percent reported feeling confident in their performance of technical skills. The researchers attributed the findings in this study to the lack of control over the types of clinical experiences residents have during their training. Nadel et al. argued that lack of clinical experiences of residents was due in part to the rarity of resuscitation events as well as to a lack of feedback to residents who participated in these situations. Lastly, the researchers proposed that curricular innovations such as resuscitation simulations and skills workshops might be one approach to ensure residents have adequate exposure to the principles and practice of resuscitation.

Nurses are educated in a similar method in which the number of critical incident experiences students have during their educational program depends on the event coincidentally occurring during the students' clinical rotations. Nadel et al. (2000) proposed that an increase in the number of care providers in the clinical setting might also preclude students from obtaining experience in these types of situations. Since it is unlikely that this competition for experiences will vanish, another approach to assuring students experience high-risk events has to be sought. Simulation may be the answer.

Morgan, Cleave-Hogg, McIlroy & Devitt (2002) examined 144 fourth-year medical student's participation in either video-assisted or simulator-assisted learning facilitated by a faculty. Simulator performance pre- and post-tests were administered to both groups. After the pre-test was completed, participants were randomly assigned to either video or human patient simulator groups. Each simulated educational session lasted 1.5 hours and was followed by a 3-hour break in which students ate lunch and participated in an educational session of the opposite type (video group was in a patient simulated session and the simulated group was in a video session). After the break, participants repeated the original simulated educational session. A statistically significant improvement in the written post-test scores was obtained in both groups ($p<.001$), however there was no statistically significant difference ($p<.296$) between the students taught by use of either the video-assisted or simulator teaching approaches. There was also no significant improvement in students' performance in the second simulated session. Both video and simulator types of faculty-facilitated educational approaches apparently offered a valuable learning environment.

Results of these studies demonstrate that simulation has a positive effect on the skill performance of participants. However because these studies used different methods of instruction and evaluation, the ability to generalize these findings to a particular method of instruction is limited.

Two studies examining the effectiveness of simulation on students' critical thinking abilities were found in the medical literature. Bond, Deitrick, Arnold, Kostenbader, Barr, Kimmel, et al. (2004) conducted a qualitative study of an educational intervention called cognitive forcing strategies. During simulation sessions, emergency medical residents (n=15, 8 in year 3 and 7 in year 2) were led to a point in a scenario in which their previous decisions took them through a series of events requiring more complex decision-making. Participation in the more complex series of events forced students to think their way out of them while trying not to make the situations worse. Upon completion of the scenario, debriefing, including reflection on one's performance was conducted. Through observation of students' performance, interviews identifying students' perceptions of the simulated scenario and anonymous completion of surveys asking for students' responses to the simulated scenario and debriefing sessions, researchers concluded that metacognitive strategies could be used to teach emergency medical residents critical thinking. Not considered in this analysis was the contextual, cognitive, psychomotor and emotional/social simulated scenario upon which the teaching was based.

More recently, Steadman and colleagues (2006) conducted a quantitative study comparing problem-based learning (PBL) and simulation (SIM) to determine whether simulation was superior to problem-based learning for training of fourth-year medical students in acute care assessment and management skills. Eligible participants (n=34) were randomly assigned to either a PBL or SIM group. The researchers provided the same instruction to all study participants on the content to be covered in the intervention sessions prior to testing. Baseline assessment was obtained followed by participant involvement in three simulation scenarios. This was followed by a final assessment with each participant assigned to a particular group. Scores were measured by objective observers using a standardized form developed by the researchers.

Steadman and colleagues (2006) found that the SIM group performed significantly better than the PBL group in the final assessment ($p<.0001$). They concluded that simulation activates psychomotor, visual, auditory and tactile learning thereby providing for greater engagement in the scenario. This is congruent with the generic influences proposed by Reisman & Kauffman (1980).

Various simulation methods that physicians use to teach medical students and residents have been presented. All the approaches described have been shown to affect critical thinking but only in the Steadman et al. (2006), study did a particular approach surface as the most effective method. Ability to replicate this study is unclear. Likewise, no specific way to evaluate students has been identified. A review of nursing education research describing the use of patient simulation follows.

Simulation in Nursing Education

There are a number of reports of patient simulation-based learning in the nursing education literature, especially in the nurse anesthetist literature (Fletcher, 1995; Monti, Wren, Haas, & Lupien, 1998; Bryans & McIntosh, 2000; Fallacaro & Crosby, 2000; Nehring, Ellise, & Lashley, 2001; Hotchkiss & Mendoza, 2001; Vandrey & Whitman, 2001; Nelson, 2003; Scherer, Bruce, Graves & Erdley, 2003). Many of these researchers discussed the theoretical basis for their use of simulation approaches and their rationale for expected improvement in skill performance and development of critical thinking skills. The one nursing study found that examined the effectiveness of simulation-based learning in developing critical thinking is presented next.

Henrichs, Rule, Grady & Ellis (2002) conducted a qualitative study in which nurse anesthetist students (n=12) participated in four simulation sessions; first, an introduction, second, an anesthetic induction, third, a minor event such as hypotension and fourth, a major event such as cardiac ischemia. Students were encouraged to keep a journal and participate in post session interviews. Researchers observed students during the simulation sessions and assessed their performance. Interviews focused on the participants' feelings about simulation sessions and their perceptions about whether changes in their critical thinking occurred because of participating. Student journals were analyzed to ascertain the students' feelings during the sessions. Comparisons between journal entries and interview answers were made to determine if students' perceptions changed over time. In this study, nurse anesthetist students' performance and critical thinking abilities improved as they participated in the simulations.

Midwifery educators completed a quantitative pilot study examining the effect simulation has on the clinical decision making of students (Cioffi, Purcal & Arundell, 2005). Clinical decision-making was defined as time taken, data collected, data review, inferences and degree of self-confidence. Thirty-six students were randomly assigned to one of two groups. Students assigned to the simulation group received simulation-based instruction on normal labor intervention and physiological jaundice topics, whereas the control group received the usual lectures. Students were then placed in pairs and evaluated in their clinical decision-making in simulated sessions. Sessions were audio taped and transcribed. Using a verbal protocol-based data collection tool, the tapes were rated by two independent raters.

Cioffi, Purcal & Arundell (2005) concluded that midwifery students who obtained their instructions via simulation were able to make decisions more quickly than the control group, however, the effect size was small; 0.5 in the labor session and 0.3 in the jaundice session. Limitations of the study include small sample size and the descriptive nature of the data collection. However, the results suggest that simulation may stimulate deeper learning than traditional methods.

Since there have only been two studies quantitatively examining the effects of simulation, it is evident that more research is needed to determine whether using patient simulation stimulates critical thinking before nursing educators embrace this rather expensive technology.

Ethical Imperative of Simulation Use

Nurse educators find themselves in similar situations to that of their medical counterparts in deciding how to teach patient management to their students. Bioethicists have long condemned the use of real patients as training tools for physicians (Lynoe, Sandlung, Westberg, & Duchek, 1998). Because of the nature of their role, APN students have also been placed in real clinical situations during their training. Unfortunately there have been times in which the student learning has occurred to the detriment of patients (Lynoe, Sandlung, Westberg & Duchek, 1998). However, with the advent of high-fidelity (extremely life-like), human patient simulation approaches to learning, it may be time for nurses and physicians to adopt this method of instruction in the development of critical thinking, removing the burden in the development of the new generation of health care providers.

In this regard, the Institute of Medicine (IOM) recently issued a report on medical errors and recommended the use of interactive simulation for the enhancement of technical, behavioral and social skills of physicians (Kohn, Corrigan & Donaldson, 1999). Numerous accounts are found in the medical literature touting the use of human patient simulation in the education of health care personnel at all levels, from student to attending physicians. Patient simulation is used for training personnel in several areas of medical care such as trauma, critical care, surgery and anesthesiology, mainly due to the extensive skill required to perform adequately the procedures and techniques germane to these areas. Several researchers have demonstrated the effectiveness of simulation in the skill development of medical personnel (Morgan, Cleave-Hogg, DeSousa & Tarshis, 2003; Nestel, Kneebone & Kidd, 2002; Lee, Pardo, Gaba, Sowb, Dicker, Straus, et al., 2003; Hammond, Bermann, Chen & Kushins, 2002). In fact in areas with low technology, such as internal medicine and in acute care areas providing less procedural skills but greater decision making requirements, the use of simulation in the education of its clinicians has progressed (Lighthall, Barr, Howard, Gellar, Sowb, Bertancini, et al., 2003; Boulet, Murray, Kras, Woodhouse, McAllister & Ziv, 2003; Ziv, Wolpe, Small & Glick, 2003). Despite the growing support for the use of simulation in nursing education, there is not yet enough evidence to support its use.

Coding Critical Thinking Behaviors

One question repeatedly asked throughout this review is whether tools used to measure critical thinking in nurses and physicians are sensitive enough to measure changes. In the studies reviewed, the tools used (WGCTA and CCTST Forms A & B) attempted to measure critical thinking in a multiple-choice testing format, however no literature in support of this format was presented by the tools' authors. Despite the questioned sensitivity of the tools, both problem-based learning approaches and the addition of simulation were demonstrated to affect positively the students' critical thinking. A search was conducted to find an alternate way of measuring and evaluating critical thinking. A behavior-coding method is described below.

Newman, Webb & Cochrane (1995) were educators of information management students who attempted to teach critical thinking to their students by requiring students to analyze computer-mediated communication scenarios. Through observations, the researchers were successful in compiling a list of critical thinking behaviors that students exhibited during both face-to-face and cooperative group learning sessions. After the list was created, the researchers performed a content analysis of the list based on a review of the literature and repeated observations of students engaged in these types of learning sessions. In 1996, Newman, Johnson, Cochrane and Webb conducted additional face-to-face and cooperative group sessions and observed the behaviors exhibited by students.

Based on these observations, they further refined their list of critical thinking behaviors. The list contained behaviors exhibited during problem solving, and also was organized into categories of behaviors exhibited as students progressed through the problem-solving exercises. The researchers supported their behavior categorizations by referring to the critical thinking stages identified by Paul (1990). The categories identified were problem identification, definition, exploration, applicability and integration, the same stages recognized by Dewey. Newman and colleagues (1996) used these categories as they further developed their critical thinking code guide to be used when analyzing discourse.

Up to this point, this coding guide had only been used to measure the critical thinking of information management students. However, in 2001, Kamin, O'Sullivan, Younger and Deterding wanted to determine whether this coding guide reliably measured critical thinking behaviors during medical student discourse. Additionally, they wanted to determine whether the guide could be used to distinguish differences between groups involved in discourse that varied only in the way the case was presented to students, in this case, third-year medical students. Problem-based learning sessions were audiotaped and then transcribed. Through an analysis of the tapes, they found that an additional category had to be added that focused on group process issues, not critical thinking issues and did not affect the critical thinking occurring during the case analysis. Based on their analysis, Kamin et al. (2001) developed a coding guide that included the five components. This coding guide, found in Table 3.2, shows the included components of categories, indicators for each category, coding labels, definitions for each indicator and qualifications or exclusion criteria for each indicator. Inter-rater reliability of the coding guide was tested by three coders, one not directly involved in the study. Inter-rater agreement was measured to range between 84 to 87 percent. The final coding guide included 5 stages, 8 categories and 35 indicators of critical thinking.

In 2001, Kamin et al. did not determine whether the revised coding guide for use with medical residents could distinguish differences between groups that varied only by the method of case presentation. Therefore, in 2003, Kamin and colleagues divided third-year medical residents between three case modalities: face-to-face with text case, face-to-face with a digital video case, and virtual with a digital video case. All sessions were audiotaped, transcribed and coded using the coding guide (Table 3.2). Behavior coding ratios were calculated for each group. A content analysis of transcripts from 13 of the 24 groups revealed that the virtual groups had the highest critical-thinking ratios, the video group was next highest and the text-only groups scored lowest. The data suggested that video presentations enhanced the critical thinking of students involved in both face-to-face and virtual problem-based learning groups.

The final version of the coding guide used in the current study had 35 critical thinking indicators or discourse behaviors that students may exhibit when involved in problem-based learning approaches. The behaviors listed on the coding guide have been repeatedly identified and therefore the coding guide has high content validity. Additionally, the coding guide has construct validity, as it is based specifically on the critical thinking categories developed by Dewey, Ennis, Paul and others.

This latest study by Kamin et al. (2003) demonstrated that the problem-based learning approach itself has an effect on the critical thinking of student participants. This finding encourages educators to use not only problem-based learning approaches as an instructional method for teaching critical thinking, but also to consider various ways to augment these approaches to have even more measurable effects.

Theoretical Framework

Facione (1990) defined critical thinking as the reasoned, purposive and introspective approach to solving problems or the consideration of issues for which an incontrovertible solution is desired. The concept of critical thinking as discussed by Facione and his colleagues included the constructs of truth-seeking, open-mindedness, analyticity, systematicity, self-confidence, inquisitiveness and maturity plus several dispositions (Facione, Facione, et al., 2001). These constructs have been supported by several of the critical thinking theorists presented earlier (Dewey, 1916; Ennis, 1987; Paul, 1990). Nurse educators value many of these constructs. Facione, Facione & Sanchez (1994) developed the California Critical Thinking Skills Tests Form A and B and most recently Form 2000 based on the findings of the APA Delphi report. Moreover, the behaviors identified by Kamin and colleagues (2001) on their coding guide are consistent with Dewey’s, Garrison’s and Paul's definitions of critical thinking and with many other critical thinking philosophers presented earlier. Therefore, this tool was employed to provide an additional measure of the construct of critical thinking.

Purpose Statement

Research examining the effects of patient simulation approaches to learning on the critical thinking of advanced practice nursing students is sparse. The purpose of this study was to examine the effect human patient simulation had on the critical thinking of advanced practice nursing students participating in case study analysis sessions, as compared to those participating in face-to-face alone sessions. It was hypothesized that the use of simulation would have no effect on the learning of students, and that these students would exhibit no more critical thinking behaviors than those engaged in the classroom-based, face-to-face learning session.

Specific Aims

The specific aims of this study were to measure baseline critical thinking ability; describe the amount of critical thinking discussion and behaviors exhibited; determine the level of critical thinking associated with problem-based learning, case study analysis sessions; compare the number of facilitator cues displayed, based on method and determine the accuracy of answers provided in the sessions. The goal was to determine if differences occur when case analyses are performed around a patient simulator or in a face-to-face method.

CHAPTER 3: METHODOLOGY

The purpose of this study was to determine the effect of patient simulation on the critical thinking of advanced practice nursing students engaged in case study analysis. An analysis of the critical thinking discourse and behaviors exhibited by participants during case study analysis was performed. The specific aims of this study were to: measure the baseline critical thinking ability; describe the amount of critical thinking discussion and behaviors exhibited; determine the level of critical thinking associated with problem-based learning, case study analysis sessions; compare the number of facilitator cues displayed based on method and determine the accuracy of answers provided in the sessions. The goal was to determine if differences occur when case analyses were performed around a patient simulator or in a face-to-face method.

The predominant research methodology for this research study was quantitative. The quantitative methodology is appropriate when quantifiable measures of variables of interest are possible, when hypotheses can be formulated and tested and inferences drawn from samples to populations (Hathaway, 1995). The quantitative design is based on positivistic thought. The positivistic approach uses experimental methods and quantitative measures to test hypothetical generalization (Hoepfl, 1997). The quantitative methods of research are designed to be detached from, and independent of, a specific situation under study in a particular organization, academic setting or classroom, providing an objective view of the phenomenon of interest.

Study Design

Consistent with these aims, the primary design for this study was a quasi-experimental design. This design allowed the opportunity to provide correlational analyses between demographic data and the subscales of the critical thinking skills test. It allowed the opportunity to manipulate the manner in which the case study was presented to each group. The treatment group was provided the details of the case with the addition of the simulator exhibiting the signs and symptoms of the patient as the discussion occurred, whereas the control group was provided only with the written details of the case to be discussed.

Settings

All case study analysis sessions were held at the University of Pennsylvania, School of Nursing's Health Care Laboratory. Written permission to use the Health Care Laboratory was obtained from the Associate Dean for Academic Programs (Appendix A). All subjects, upon obtaining consent, agreed to come to the Health Care Laboratory to participate in the case sessions. Before recruiting subjects, approvals by Drexel University's Non-medical Institutional Review Board (IRB) and the University of Pennsylvania's Committee for the Protection of Human Subjects were obtained to assure human subjects protection.

Sample and Sampling Procedures

According to the AACN (2004), approximately 2400 nurse practitioner students graduate from programs annually. The American Association of Nurse Anesthetists (AANA) Council on Certification estimated that 1628 nurse anesthesia graduated in 2004. In an attempt to obtain a representative sample of these advanced practice nursing groups, a purposive sampling approach was employed.

To determine the sample size needed a power analysis for a 2 x 2 fixed effects analysis of variance was performed. This study included 32 cases per cell in a balanced design, resulting in 128 cases. Face-to-face case study analysis included 2 levels with 64 cases (individuals) per level. The effect size was 0.25, yielding a power of 0.80. Similarly, simulation-centered case study analysis sessions included 2 levels with 64 cases per level. This effect size was 0.25, yielding a power of 0.80. A power of 0.80 provides sufficient power to avoid a type II error (Kerlinger & Lee, 2000). The interaction of face-to-face and simulation case analysis was 0.00 yielding a power of 0.05.

Employing the purposive sampling frame, volunteers were required to hold a minimum of a bachelor's of science degree in nursing and possess an active license to practice nursing. Additionally, they were required to be matriculated either full or part-time in a master's of science in nursing degree-granting nurse practitioner or nurse anesthesia program; enrolled in or have completed at least one graduate level course prior to their participation and be willing to come to the University of Pennsylvania, School of Nursing's Health Care Laboratory to participate. Subjects with a prior master's of science in nursing degree, and those who were enrolled in graduate degree programs that did not lead to becoming either a nurse practitioner or nurse anesthesia were excluded from participation.

Recruitment of Subjects

Participants were recruited from advanced practice nursing programs in the Greater Philadelphia region. Recruitment flyers were sent to directors of master's programs in area schools of nursing. Follow-up conversations with program directors were held to explain the purpose of the study and answer questions. Directors, who agreed, displayed recruitment flyers in student common areas. Interested students were asked to call the researcher for further information and to obtain consent. Table 3.1 shows the nursing schools from which students were recruited.

Table 3.1 Nursing Schools in Which Subjects Were Recruited

School	N	Total N=147
Drexel University	4	
Gwynedd Mercy College	0	
LaSalle University	2	
Rutgers University	0	
Temple University	0	
Thomas Jefferson University	2	
University of Delaware	0	
University of Medicine and Dentistry of New Jersey	0	
University of Pennsylvania	139	
Villanova University	0	
Widener University	0	

One-hundred forty-seven subjects were recruited based on the inclusion criteria described above. After assuring that inclusion criteria were met and that the subject agreed to be videotaped during the case analysis session, informed and signed consent was obtained (See Appendix B).

Procedures

Once consent was obtained, subjects were given instructions regarding accessing the Insight Assessment© website at www.insightassesment.com to complete the demographic data form (Appendix C) and the California Critical Thinking Skills Test (CCTST), Form 2000. Each participant received a unique login and password to use when logging into the data and testing area. After logging in, subjects completed the demographic data form. When finished, subjects advanced to the section where they completed the CCTST.

Instruments

Demographic Data Form

The data form included contact information, age, gender, ethnicity, school enrolled, grade point average, program enrolled, number of courses completed, whether clinical courses were started, years of nursing experience and whether they had previous simulation experience. Appendix C includes a copy of the demographic data form.

California Critical Thinking Skills Test

Based on the findings of the American Psychological Associations' Delphi study, Facione and his colleagues created the California Critical Thinking Skills Test (Facione, Facione & Sanchez, 1994). The California Critical Thinking Skills Test (CCTST) form 2000 is a 34-item, multiple-choice test that targets core critical thinking skills thought to be essential in collegiate education. The validity of the CCTST is addressed in three components: content validity, construct validity and criterion validity. Content validity refers to how well the specific test items represent the universe of possible test items within a specified domain, in this case, critical thinking (Facione, Facione, Blohm & Giancarlo, 2002). Each of the items included in the CCTST was chosen based on its theoretical relationship to the Delphi Panel's conceptualization of critical thinking

(Facione, et al., 2002). The items chosen for inclusion cover five areas of cognitive skills identified by the Delphi experts. These areas are interpretation, analysis, evaluation, explanation and inference; areas that are discipline neutral.

Construct validity refers to the extent to which the test measures the actual construct, in this case the ability to measure the experts' conceptualization of critical thinking. Extensive testing by the authors has been done with large populations of students and the CCTST has been found to have high construct validity.

The last type of validity is criterion validity. Criterion validity refers to the test's ability to be predictive of some external criterion in this case whether the CCTST score has a high correlation with some gauge of academic success (Facione et al., 2002). The CCTST is reported to have a validity of .74 and has been shown to have moderate criterion validity with grade point average and both math and verbal scholastic aptitude test (SAT) scores. The internal consistency (reliability), as estimated by the Kuder-Richardson 20 ranges from .68 to .70. Reliability scores traditionally accepted are above .80, for tools evaluating a single concept. Since the CCTST evaluates five sub-areas of critical thinking, a Kuder-Richardson 20 score of .68-.70 is acceptable (Facione, et al., 2002) as a multiple construct instrument.

The California Critical Thinking Skills Test (CCTST) Form 2000 consists of five sub-scales of critical thinking identified as induction, deduction, analysis, inference and evaluation. Analysis is defined as the ability to comprehend and express the meaning or significance of a variety of materials, situations and expressions.

Analysis includes the ability to identify intended and actual inferential relationships among statements, questions, concepts, beliefs, or judgments (Facione & Facione, 1997).

The evaluation subsection assesses the ability to determine the credibility of statements and the logical strength of inferential relationships. Evaluation assesses the ability to justify one's reasoning by reference to relevant evidence, concepts, methods, standards and context (Facione & Facione). Inference refers to the ability to identify and secure the elements needed to draw reasonable conclusions, form conjectures and hypotheses and consider relevant while ignoring extraneous information. Further included in inference is the ability to take this a step further and include the most reasonable consequences that most probably will follow from these elements (Facione & Facione). The more common concepts of deduction and induction are measured by the CCTST as well. Deduction refers to the assumed truth of the information provided which necessitates the truth of the inference drawn or more easily understood as reasoning from the general to the specific. In contrast, induction refers to the ability to determine an argument's conclusion is purportedly warranted but not necessitated, by the assumed truth of its premises or more commonly considered as moving from the specific to the more general (Facione & Facione).

Coding of Critical Thinking

The critical thinking (CT) discourse and behavior coder and the researcher viewed the videotapes together and both separately coded the discourse and behaviors exhibited by the subjects, using the coding form found in Table 3.2. Codings were compared and clarifications made. A consistent approach to coding the discourse and behaviors was determined. Only one CT coder participated in the entire study. Subjects were compensated with a $10 Barnes & Noble Bookstore gift card and were provided with their CCTST results. Additionally, subjects were entered into a raffle to win either an

IPOD Nano™ or a personal digital assistant (PDA), approximately a $300 value.

The critical thinking coding form (CTCF) refined by Kamin, O'Sullivan, Deterding & Younger (2003) was used to code both verbalizations and behaviors occurring during case analysis (See Table 3.2). The CTCF is comprised of five stages of critical thinking and one section for group process issues. This last section is not used when considering CT. The five critical thinking stages are problem identification, problem description, problem exploration, applicability and integration. Each stage is composed of categories and indicators. The categories of new information, clarifying concepts, outside knowledge, linking ideas, justification, practical utility, teaching and critical assessment were used to assist the coder in determining into which stage to code the discourse or behavior. Within each category, indicators further assist the coder in applying the discourse or behavior to the appropriate stage. Each verbalization or behavior was coded only once, therefore these indicators further clarified the CT stage to be tallied. The indicators can be considered as representing a continuum of CT within each stage, with opposite ends representing surface and deep learning. Surface learning discourse and behaviors were most closely associated with impatience and frustration regarding the information provided and with the subjects' perception of way the analysis was unfurling. Deep learning discourse and behaviors were associated with progression of the analysis and comments leading to its eventual completion. A CT discourse and behavior frequency table was created for each subject. A CT ratio was calculated for each CT stage, ranging between -1 and +1. This ratio represented the quality of the discourse and behaviors and was independent of the quantity of discussion.

Table 3.2 Critical Thinking Coding Form

Subject Number ______	Group Number ______ Type of Session ______	Date _____
Critical Thinking Behavior Classifications	**Critical Thinking Behaviors**	**Frequency Behavior Exhibited**
Problem Identification		
Imparting New Information		
	Offering new problem-related information	
	Repeating information that has already been said	
	Asking for information not provided yet	
	Complaining or repeatedly asking for information that cannot be provided	
Problem Description		
Clarifying or Agreeing on Terms and Concepts		
	Discussing ambiguities or facts to clarify them.	
	Ignoring or exhibiting impatience with ambiguities	
	Identifying what the group or individual needs to know including admitting when the answer is not known or agreeing which phenomena requires explanation	
	Offering information whereby the facilitator teaches rather than facilitates;	
	Students respond "yes" or "no" to questions with no explanation.	
	Bringing Outside Knowledge Experience to Bear on Problem	
	Drawing on personal experience	
	Drawing on irrelevant personal experience distracting group from case	
Problem Exploration		
Linking Ideas, Interpretation		
	Linking facts or ideas	
	Repeating information without making inferences or offering an interpretation or stating that one shares the ideas or opinions stated without elucidating or adding any personal comments	
	Interpreting the data or the text material	
	Interpreting the data or the video material	
	Complaints about technology with regard to the text, video, and computer	
	Guiding or focusing the group by synthesizing where the group is or what they need to do, asking about reasoning, and asking probing questions.	
	Asking closed-ended questions that require rote memory skills thereby ending critical thinking process	

Critical Thinking Behavior Classifications	Critical Thinking Behaviors	Frequency Behavior Exhibited
Justifying		
	Developing working hypotheses, which is the brainstorming stage when all possible explanations are listed	
	Unwillingness to explore other possible solutions or explanations for the problem	
	Justifying hypotheses, orders or actions by providing examples or explaining reasoning; comparing the advantages and disadvantages of hypotheses, orders, or treatment; moving hypothesis ranking up, down or out	
	Offering irrelevant or obscuring justification for hypotheses; agreeing but not adding any comments; being noncommittal	
Applicability		
Applying Practical Utility		
	Discussing practical utility or concerns about approaches to patient, lab orders, or treatment	
	Suggesting impractical orders or treatment or ordering tests unable to relate to hypotheses list; agreeing without adding any new or reasons for the agreement	
Integration		
Teaching Each Other		
	Synthesizing learning issues and application to problem; linking findings after self-study to hypotheses; generalizing to the broader application	
	Reporting learning issue with no synthesis or relation to problem	
Offering Critical Assessment		
	Student provides self- or peer assessment	
	Student is superficial or unwilling to assess self or peers	
	Tutor provide self-assessment, group assessment or student assessment; prompts students for self-or peer assessment	
Group Process Issues		
	Building rapport; active listening, affirmation, introductions, volunteering	
	Explaining process, questions about process	
	Dividing learning issues	
	Voting on orders or hypotheses by a show of hands	
	Number of times facilitator cues group	
	Number of correct answers provided by individual	

Source: Kamin, C.S., O’Sullivan, P.S., Younger, M., & Deterding, R. (2001) Coding Guide

Both the session facilitator and the behavior coder were master’s prepared nurses who worked as advanced practice nurses; the facilitator as a clinical educator and the coder as an acute care nurse practitioner, both dealing with adult patients. Both facilitator and coder were trained in their respective responsibilities within the study and provided an opportunity to clarify and refine their approaches. Once comfortable with their roles, the process was standardized so that their approach to facilitating or coding did not interfere with the study results.

Case Analysis Sessions

Subjects were then randomly assigned to participate in one of four case analysis sessions; face-to-face-case A, face-to-face-case B, simulation-case A, or simulation-case B. A mutually convenient appointment was made for the subject to participate in the case session. Two to six subjects were permitted to complete the analysis sessions at the same time. Before each session began, the video camera was set up and started. At the end of the session, videotapes were collected, labeled with the date, type of group and the group code.

During SIM sessions, the patient simulator displayed the signs and symptoms of the patient presented in the case scenario, and responded to the care decisions made by subjects. The facilitator guided the subjects' discussion through five elements regarding the case in a similar manner for both face-to-face and simulation sessions.

Pilot Testing

Prior to commencing the main study, a pilot study was conducted to test the case analysis format and to provide a means of training both the session facilitator and the behavior coder. Ten subjects who met the inclusion criteria as noted above, completed all aspects of the study as outlined. Guided design cases, as opposed to free inquiry, were utilized in this study as a means of limiting the diversity of responses. The facilitator’s role in the sessions was to assist the participant in developing a treatment plan while keeping a CT focus to the sessions. An introduction to the simulated sessions was scripted for consistency (See Appendix D). The case analysis format and both Cases A and B are found in Appendix E. Both formats, face-to-face (FTF) and simulated (SIM) were tested. The videotapes were reviewed by the facilitator and researcher together and adjustments made to format and style. A consistent approach to the case studies was clarified and adhered to throughout the entire study. One facilitator conducted all of the sessions. Camera placement and audio quality were analyzed during the pilot study and the need for an additional microphone was identified.

At the beginning of each session, an orientation to the session format was provided. For the simulation-centered groups, a brief orientation to the simulator and room was provided before the session started (Appendix D). Once the orientation was completed, subjects were given a copy of the case study to read. The facilitator also read the scenario aloud to the subjects before beginning the discussion. Each group, with the assistance of the facilitator, was asked to discuss the salient aspects of the case and to consider five elements about the case.

Facilities and Resources

The Matthias J. Brunner Technology Laboratory of the University of Pennsylvania, School of Nursing was the facility used to conduct the simulation sessions. Permission was obtained from the Associate Dean for Academic Programs (Appendix A). Availability of the laboratory was coordinated with the Laboratory Director.

Data Analysis

Nominal data from demographic data forms were compiled. Individual critical thinking scores from the CCTST, including sub-scores were compiled. Critical thinking discourse and behavior frequency scores were calculated for each participant. A correlational analysis of demographic data, CCTST scores, and critical thinking discourse and behavior scores comparing individuals, groups and composite results of the face-to-face and simulator groups was conducted.

A two-sample, non-directional *t* test was used to compare CCTST scores between face-to-face and simulation groups and case A and B participants. Based on the results of these analyses, it was determined that no significant differences existed between the cases and therefore the analyses could be performed between the methods by using data at the individual participant level. Therefore, the results presented are those of the 128 individuals who completed all phases of the study. Correlational analyses and linear regression analyses between demographic data and the CCTST scores and critical thinking discourse and behavior scores were conducted.

The Statistical Package for Social Sciences (SPSS) version 12.0 was used for the analysis of quantitative data. Descriptive statistics were used to analyze demographic variables. Non-parametric correlations were employed to assess association among study variables. The relationship between demographic variables and the subcategories of the CCTST was analyzed using non-parametric methods. Linear regression analysis was used to determine if age, grade point average, years of nursing experience, and California Critical Thinking Skills Test sub scores were predictors of critical thinking discourse and behaviors. An independent samples t test was used to analyze the CT ratios between face-to-face and simulation groups. A P value of less than .05 was considered statistically significant.

The criterion for methodological rigor when using a quantitative paradigm is based on validity and reliability of research methods and the ability to generalize the research findings. The tools used to measure baseline critical thinking and participant CT discourse and behaviors both have an acceptable level of validity and reliability. The power analysis performed recommended a large enough N to prevent a type II error.

Protection of Human Participants

Managing and Storing Raw Data

All session videotapes were maintained in a locked filing cabinet. The demographic data and CCTST results were maintained on the Insight Assessment® website. All participants were identified by their login codes only.

Privacy and Confidentiality

Information pertaining to study participants was kept strictly confidential and managed in accordance with the requirements of the IRB. Consent forms were maintained in a locked filing cabinet. Nine participants revoked their consent to participate in the study citing time constraints as the primary reason.

Record Retention

The study related materials were kept in a locked filing cabinet at all times. All coding sheets were maintained with a unique identifier (UI) on them, the videotapes were coded by date and session type and the UI of the participants. The demographic data, CCTST scores and CT discourse and behavior coding scores were maintained on spreadsheets that were password protected. Data within these spreadsheets were maintained via the UI.

Monitoring and Auditing

All study-related documents (e.g. source documents, regulatory documents and data collection tools) are available for audit by authorized auditors, or those allowed by law. These include study-related monitoring, audits, and inspections by the concerned IRBs, sponsors and the government regulatory bodies.

Ethical Considerations

The investigator and the trained facilitator and coder completed the relevant human subject and privacy training required by both Drexel University and University of Pennsylvania. This investigation was conducted in accordance with United States and international standards of Good Clinical Practice and regulations promulgated by each of the institutions involved.

The study protocol along with written informed consent, subject authorization form and study instruments were submitted to the appropriate IRBs for their approval, and a continued approval was sought at the completion of the first year of study. All data collection began after appropriate receipt of approval from the concerned institutions. The verification documents including the exact protocol title, number, date of approval, and validation were kept on file by the investigator. Any information about amendments related to study protocol were promptly submitted to the concerned IRB offices and maintained in the file.

Strategies for Insuring Informed Consent

The consent form was written in English at a sixth grade level as assessed by using the Flesch-Kincaid Grade Level assessment. Participants had the opportunity to read the consent form, ask questions of the investigator and if desired, seek legal advice before signing the form. Questions were encouraged and as much clarification of study details was provided before, consent was obtained. After subjects accurately described the purpose, benefits and risks of participation in the study, they were asked to sign the consent form in the presence of the investigator and a witness. The investigator's and key personnel telephone numbers were listed on the consent form in case a subject required additional information about the study or wished to withdraw.

Potential Risks and Protections

Although the study posed no direct physical harm to subjects, there was a theoretical risk of psychological distress due to the nature of the case study analysis sessions being conducted in groups of at least two. The following measures were employed to minimize psychological harm to subjects: (1) subjects were encouraged to ask questions and make an informed choice to participate in the study; (2) information was provided about the potential psychological impact resulting from participating in the study; (3) an explanation about the right to decline to answer any questions on the demographic data form or to not provide responses during the case study analysis was provided, as well as the subjects right to withdraw from the study at any time; (4) written telephone numbers to contact the investigator or key personnel were provided to the participants on the consent form; (5) measures were taken to protect the privacy and confidentiality of participants in accordance with all rules and regulations.

CHAPTER 4: RESULTS

One hundred and forty seven advanced practice, nursing students enrolled in either nurse practitioner or nurse anesthesia programs were recruited to participate in the study. Nine subjects withdrew from the study, before any data were collected on them, citing time constraints as the reason for their inability to participate. Excluding those who participated in the pilot, 128 APN students completed all phases of the research study. The results presented in the subsequent sections of this chapter include only those obtained from these 128 study participants.

Demographic Characteristics

One hundred and seven females and twenty-one males participated in the study. All 128 subjects were BSN-prepared nurses currently enrolled in either a nurse practitioner or nurse anesthesia program leading to a Master's of Science in nursing degree.

The sample was composed primarily of Caucasians (102), with others identifying themselves as Black (5), Asian, Pacific Islanders (16), and Hispanics (2). Two subjects did not identify with any group listed.

Table 4.1 presents the demographic characteristics of the sample. The age of subjects ranged from 23 to 55 years of age with the mean age of 30.73. The median and mode of the age of the participants was 26 years. Previous nursing experience ranged between 0 to 27 years with a mean of 5.7 years. A majority of the sample had adult intensive care unit experience (68) while others worked in a variety of settings. Table 4.2 shows the distribution of participants by APN program, while area of previous nursing experience reported by participants is displayed in Table 4.3. The majority of participants had previous intensive care unit experience and enrolled in an acute care nurse practitioner program.

Table 4.1 Demographic Characteristics of Sample

Gender	Male =	21			
	Female =	107			
	Mean	Median	Mode	Maximum	Minimum
Age	30.73	26	26	23	55
Yrs Exp	5.7	4.0	1	27	0
GPA	3.67	3.70	4.0	4.0	3.0

Table 4.2 Participants by APN Program

APN Program	Number of Participants	Percent of N
Adult Acute Care NP	65	50.8
Adult Oncology NP	4	3.1
Gerontology NP	5	3.9
Midwifery/Women's Health NP	6	4.7
Nurse Anesthesia	29	22.7
Peds/Neonatal ICU NP	7	5.5
Peds Acute Care NP	2	1.5
Peds Oncology NP	2	1.5
Pediatric Primary Care NP	2	1.5
Primary Care Family NP	6	4.7
Cumulative	128	99.9

The grade point average (GPA) of sample ranged from 3.0 to 4.0 on a 4.0 scale. The mean GPA of participants was 3.67, with a median of 3.7 and a mode of 4.0. Two-thirds of the sample was enrolled in clinical courses at the time of participation (81 to 47) and a majority of subjects (77) had completed more than half of the APN program before participating. Approximately two thirds of the sample reported previous experience with simulation (80 to 48).

Descriptive statistics for participant demographics of age, years of nursing experience and GPA were calculated for all subjects, classified by the type of session in which they participated, and are presented in Tables 4.1 and 4.4. Table 4.4 displays the means of age of subjects in years, number of years of nursing experience and GPA of subjects by method of session. The difference in age between groups was 1.42 years with the simulation; the case B group had the youngest subjects and the face-to-face case B group had the oldest subjects. The difference in mean years of nursing experience between groups was 1.20 years. The difference in mean GPA of participants between groups was 0.15. Regardless of these small differences in age, years of nursing experience and GPAs of the subjects, the characteristics were evenly distributed between sessions.

California Critical Thinking Skills Tests Results

Descriptive statistics for the California Critical Thinking Skills Test scores for all subjects are found in Table 4.5. Table 4.6 displays the range and means for the subscale scores of the CCTST for the four sessions.

The possible total score on the CCTST was 34. Subscale scores on the instrument ranged as follows: analysis (1 to 9), evaluation (1 to 14), inference (1 to 11), deduction

Table 4.3 Participants by Area of Previous Nursing Experience

Experience Area	Number of Participants	% of Total
Community	3	2
Flight	1	1
Education	1	1
Emergency Room	7	6
Gerontology	2	2
Intensive Care Area - Adult	68	50
Medical/Surgical – Adult	16	13
Nursing School	3	2
Oncology- Adult	5	4
Operating Room	2	2
Neonatal ICU	2	2
Pediatric Critical Care	9	7
Pediatric Emergency Room	2	2
Pediatric Oncology	2	2
Psychiatric	1	1
School	1	1
Women’s Health	3	2
Cumulative	128	100

Table 4.4 Demographic Characteristics by Method and Group

Method/Group	Age	Years of Experience	GPA
FTFA	31.05	6.5	3.74
SIMA	31.19	5.9	3.68
FTFB	31.3	5.2	3.56
SIMB	29.10	5.06	3.73

FTFA = Face-to-face session, case A; FTFB = Face-to-face session, case B
SIMA = Simulator session, case A; SIMB = Simulator session, case B

Table 4.5 Descriptive Statistics for the CCTST Test of Composite Group

	N	Range	Min.	Max.	Mean	S.D.	Mode	Median
Induction	128	12	4	16	11.72	2.528	13	12
Deduction	128	12	3	15	9.68	2.644	8	10
Analysis	128	6	2	8	5.04	1.193	5	5
Inference	128	11	4	15	10.27	2.601	11	11
Evaluation	128	12	0	12	6.14	1.991	5	6
Total	128	22	8	30	21.4	4.387	19	21

(1 to 16) and induction (1 to 14). The sum of the three sub scores of analysis, inference and evaluation is equal to the total score (Facione & Facione, 2000). Low scores indicate that subjects may have greater difficulty practicing at the advanced level and have difficulty thinking through complex issues and problems at the graduate level

(Facione & Facione). Table 4.7 displays aggregate MSN student data provided by Facione & Facione (2000), creators of the CCTST, to be used for comparison purposes. Means are higher in the present study than in the composite data in all sub scores, except for analysis and evaluation, which are approximately same. The most notable difference in sub scores is found in the induction means, where the composite mean of 7.69 was reported while the present study mean was 10.27. The total CCTST of the present study was 21.4 compared to a score of 17.0 of the aggregate data.

As noted in Table 4.6, little variation existed between subjects related to the type of case completed. Thus, variance between the behaviors and discourse displayed in Table 4.9 is associated with the method used (FTF vs SIM) and not related to a lack of homogeneity between subjects in each method group.

Critical Thinking Discourse and Behaviors

The critical thinking coding form (CTCF) refined by Kamin and colleagues (2001) and found in Table 4.8, was based on Garrison's five stages of critical thinking. This form was used in the present study to code the discussion and behaviors exhibited by subjects during the case study sessions. Critical thinking according to the categorization on the CTCF is divided into five sections: 1) problem identification, 2) problem description, 3) problem exploration, 4) applicability and 5) integration. The discourse and behaviors exhibited by each participant during the case analysis sessions were tabulated, during videotape coding. The coding form breaks down the tabulated discourse and behaviors into deep or surface critical thinking. Behaviors and discourse adding to the case analysis and productive to problem solving were considered deep critical thinking (DCT). An overall critical thinking score (ALLCT) was computed that included both deep and surface critical thinking scores. A ratio (RAT) between these two values; deep critical thinking (DCT) and all critical thinking (ALLCT) was calculated for each category and compared between session methods. This ratio is thought to be the more meaningful score obtained from the CTCF as it reflects on a scale between -1.0 to +1.0 whether more meaningful critical thinking was generated.

Ratios of all five stages of critical thinking in all case study sessions were greater than 0.00 showing that deep critical thinking occurred during case analyses. Comparisons of mean scores between face-to-face and simulation were found to be significantly greater ($p<0.01$) in the simulation sessions during the problem exploration stage. Deep critical thinking mean scores during the integration phase were also found to be significantly greater ($p< 0.01$) in simulation sessions than in the face-to-face sessions. According to Garrison, learners involved in the problem exploration stage obtain insight into the problem using inference, induction and deduction. Creative solutions to the problem are formulated, ideas are linked and assumptions made. In the applicability and problem evaluation stage, learners evaluate what has been accomplished to this point. Decision-making is a large component to this stage including an evaluation of the progress and mistakes made, and determining what else needs to be done.

Using the t test for independent samples, an analysis of equality of means was performed. Table 4.9 displays the descriptive statistics for the samples as they relate to the method of case analysis; method 0 was the face-to-face and method 1 was the simulation method. Table 4.10 presents the results of the independent samples t test for equality of means between methods of case analysis.

Levene's Test for Equality of Variances results are presented in Table 4.10 to direct the reader to the appropriate t test mean used for analysis. When performing a t test, the null hypothesis considers that the variances are equal. Levene's Test provides a comparison of the standard deviations between the means being tested, with a significance level for the variances. If the p value for Levene's Test is <0.05, the null hypothesis that the variances between the two means being tested are equal is rejected and the t test values used for analysis are those found in the "equal variances not assumed" row.

Once it is determined whether the variances are equal or not, the t test results are analyzed. When the t value is a positive number and the p value is significant, the first method entered into the calculation is the independent variable associated with the results. Conversely, if the t result has a negative value and the p value is significant, the second method entered into the calculation is the independent variable associated with the results. In reviewing the results displayed in Table 4.10, PERAT has a negative t value and a significant p value, suggesting that simulation increases the critical thinking behaviors and discourse of participants, at a significance level of $p<0.05$. The results for INTDCT, when considering the variances are unequal; the p value is significant at the $p < 0.05$. This category has a negative t value, again interpreted to mean that the simulation method significantly affected the critical thinking of subjects in these two categories.

Linear regression analysis of the critical thinking discourse and behavior ratios was performed entering all of the following variables: grade point average, years of previous nursing experience, gender, age and method. Using these factors as coefficients, method was found to be statistically significant ($p < .01$) suggesting that simulation generates more critical thinking than the face-to-face method. The simulation method was found to be the statistically significant coefficient for INTDCT ($p<.05$) also.

Table 4.6 Descriptive Statistics for CCTST Subscale Scores by Method and Case

Subscale	Range	Minimum	Maximum	Mean
Induction				
FTFA	9	8	16	11.64
SIMA	13	4	16	11.07
FTFB	12	5	16	11.58
SIMB	8	9	16	12.41
Deduction				
FTFA	9	6	14	9.51
SIMA	12	4	15	10.21
FTFB	10	3	14	9.04
SIMB	11	5	15	10.03
Analysis				
FTFA	6	3	8	5.09
SIMA	6	2	7	5.16
FTFB	5	3	7	4.98
SIMB	5	3	7	4.98
Inference				
FTFA	10	5	14	9.71
SIMA	11	4	14	10.85
FTFB	11	4	14	10.04
SIMB	9	7	15	10.91

Evaluation				
FTFA	9	4	12	6.48
SIMA	8	2	9	5.56
FTFB	11	0	10	5.61
SIMB	7	4	10	6.80
Total				
FTFA	16	16	30	21.16
SIMA	23	8	30	21.57
FTFB	20	8	27	20.62
SIMB	17	14	30	22.43

FTF = Face-to-face method, SIM = Simulation method, A = Case A, B=Case B

Table 4.7 Descriptive Statistics for CCTST Scores of MSN students of Aggregate Data

Subscale	N	Range	Min	Max	Mean	S.D.
Induction	459	14.00	1.00	14.00	7.69	2.68
Deduction	460	13.00	2.00	15.00	8.06	2.61
Analysis	553	8.00	1.00	9.00	5.00	1.54
Inference	552	11.00	0.00	15.00	6.00	2.06
Evaluation	551	14.00	0.00	14.00	6.58	2.58
Total	633	24.00	5.00	29.00	17.00	4.81

Source: Facione, N. & Facione, P. (2000). Critical thinking assessment in nursing education programs: an aggregate data analysis. Millbrae, CA: The California Academic Press.

Table 4.8. Critical Thinking Coding Form

Subject Number ______	Group Number ______ Type of Session ______	Date _____
Critical Thinking Behavior Classifications	**Critical Thinking Behaviors**	**Frequency Behavior Exhibited**
Problem Identification		
Imparting New Information		
	Offering new problem-related information (d)	
	Repeating information that has already been said (s)	
	Asking for information not provided yet (d)	
	Complaining or repeatedly asking for information that cannot be provided (s)	
Problem Description		
Clarifying or Agreeing on Terms and Concepts		
	Discussing ambiguities or facts to clarify them. (d)	
	Ignoring or exhibiting impatience with ambiguities (s)	
	Identifying what the group or individual needs to know including admitting when the answer is not known or agreeing which phenomena requires explanation (d)	
	Offering information whereby the facilitator teaches rather than facilitates; (s)	
	Students respond “yes” or “no” to questions with no explanation.(s)	
	Bringing Outside Knowledge Experience to Bear on Problem (d)	
	Drawing on personal experience (d)	
	Drawing on irrelevant personal experience distracting group from case (s)	
Problem Exploration		
Linking Ideas, Interpretation		
	Linking facts or ideas (d)	
	Repeating information without making inferences or offering an interpretation or stating that one shares the ideas or opinions stated without elucidating or adding any personal comments (s)	
	Interpreting the data or the text material (d)	
	Interpreting the data or the video material (d)	
	Complaints about technology with regard to the text, video, and computer (s)	
	Guiding or focusing the group by synthesizing where the group is or what they need to do, asking about reasoning, and asking probing questions. (d)	
	Asking closed-ended questions that require rote memory skills thereby ending critical thinking process (s)	

Critical Thinking Behavior Classifications	**Critical Thinking Behaviors**	**Frequency Behavior Exhibited**
Justifying		
	Developing working hypotheses, which is the brainstorming stage when all possible explanations are listed (d)	
	Unwillingness to explore other possible solutions or explanations for the problem (s)	
	Justifying hypotheses, orders or actions by providing examples or explaining reasoning; comparing the advantages and disadvantages of hypotheses, orders, or treatment; moving hypothesis ranking up, down or out (d)	
	Offering irrelevant or obscuring justification for hypotheses; agreeing but not adding any comments; being noncommittal (s)	
Applicability		
Applying Practical Utility		
	Discussing practical utility or concerns about approaches to patient, lab orders, or treatment (d)	
	Suggesting impractical orders or treatment or ordering tests unable to relate to hypotheses list; agreeing without adding any new or reasons for the agreement (s)	
Integration		
Teaching Each Other		
	Synthesizing learning issues and application to problem; linking findings after self-study to hypotheses; generalizing to the broader application (d)	
	Reporting learning issue with no synthesis or relation to problem (s)	
Offering Critical Assessment		
	Student provides self- or peer assessment (d)	
	Student is superficial or unwilling to assess self or peers (s)	
	Tutor provide self-assessment, group assessment or student assessment; prompts students for self-or peer assessment (d)	
Group Process Issues		
	Building rapport; active listening, affirmation, introductions, volunteering	
	Explaining process, questions about process	
	Dividing learning issues	
	Voting on orders or hypotheses by a show of hands	
	Number of times facilitator cues group	
	Number of correct answers provided by individual	

Source: Kamin, C.S., O’Sullivan, P.S., Younger, M., & Deterding, R. (2001) Coding Guide. d=deep, s=superficial

Linear regression analysis was performed using the sub scores of the CCTST against the categories of the CTCF. Evaluation sub scores of the CCTST were found to be statistically significant predictors ($p<.05$) of the problem identification deep critical thinking score (PIDCT) and of the applicability deep critical thinking score (APPDCT). Table 4.11 provides the coefficients, t values and level of significance for the factors discussed.

A factor yet to be reviewed that has potential effects on the outcomes of case analysis sessions is the facilitator role. The facilitator was responsible for moving participants through the analysis, assuring that session objectives were met, while teaching participants certain elements related to the case. One point of interest in this study was determining whether the number of cues provided by the facilitator was affected by the method employed or vice versa. A correlational analysis of the number of facilitator cues provided during the sessions comparing the means by case method was performed revealing no correlation. A t test for independent samples was performed using method against number of facilitator cues and again no significant findings were discovered.

Summary

The results of this study indicate that simulation sessions produced significantly ($p< .01$) more critical thinking during the problem exploration phase (PERAT) and the integration phase INTDCT of case analysis, than did the face-to-face method. The PERAT was the ratio of deep to superficial critical thinking comments and behaviors occurring during the treatment-planning phase, based on information gathered earlier during the problem identification and description phases. The INTDCT category was the deep critical thinking comments and behaviors occurring during the integration phase when the plan of care is implemented and its appropriateness is determined.

Grade point average and grade point average combined with years of nursing experience were found to be significant ($p<.05$) predictors of critical thinking during the problem identification phase; the higher the grade point average and more years of experience led to more critical thinking. Years of nursing experience were found to be a significant ($p<.05$) predictor of critical thinking during the problem exploration phase also, again the more experience, the more critical thinking that occurred. Age was found to be a significant ($p<.05$) predictor of critical thinking during the integration phase of case analysis; the older the subject, the more critical thinking was generated.

Upon analyzing the sub scores of the CCTST, evaluation was determined to be a significant predictor ($p<.05$) of the deep critical thinking that occurred during both the problem identification and applicability phases of case analysis.

Table 4.9 Descriptive Statistics for Critical Thinking Behaviors by Method

	Method	N	Mean	Std. Deviation	Std Dev. Mean
PIDCT	0	67	7.6567	6.70041	.81859
	1	61	9.2623	7.34144	.93997
PIALLCT	0	67	10.6418	7.75320	.94720
	1	61	11.7869	8.22215	1.05274
PIRAT	0	67	.7827	.35334	.04317
	1	61	.7954	.24535	.03141
PDDCT	0	67	8.6119	7.41406	.90577
	1	61	7.7869	6.12676	.78445
PDALLCT	0	67	9.3881	7.75761	.94774
	1	61	8.5410	6.97274	.89277
PDRAT	0	67	.8705	.27006	.03299
	1	61	.9299	.26520	.03396
PEDCT	0	67	8.4925	9.21523	1.12582
	1	61	10.3770	8.12437	1.04022
PEALLCT	0	67	15.8060	10.75236	1.31361
	1	61	15.4590	13.12704	1.68074
PERAT	0	67	.5329	.43222	.05280
	1	61	.7437	.39635	.05075
APPDCT	0	67	7.2836	4.96901	.60706
	1	61	8.3443	5.98856	.76676
APPALLCT	0	67	12.9254	9.82470	1.20028

	1	61	12.7049	9.61656	1.23127
APPRAT	0	67	.7232	.34123	.04169
	1	61	.7741	.35289	.04518
INTDCT	0	67	1.3284	1.69123	.20662
	1	61	2.5246	2.74230	.35112
INTALLCT	0	67	1.3284	1.69123	.20662
	1	61	2.5902	2.91763	.37356
INTRAT	0	67	.6269	.48729	.05953
	1	61	.6831	.46518	.05956

Method 0 = Face-To-Face; Method 1 = Simulation

Table 4.10 t test for Critical Thinking Behaviors and Discourse

		Levene's Test for Equality of Variances		t-test for Equality of Means		95% Confidence Interval of the Difference Lower	Upper
		F	Sig.	T	Sig. (2-tailed)	Mean Difference	Std. Error Difference
PIDCT	Equal variances assumed	1.517	.220	-1.294	.198	-1.60558	1.24109
	Equal variances not assumed			-1.288	.200	-1.60558	1.24645
PIALLCT	Equal variances assumed	.390	.533	-.811	.419	-1.14509	1.41222
	Equal variances not assumed			-.809	.420	-1.14509	1.41614
PIRAT	Equal variances assumed	4.338	.039	-.234	.815	-.01272	.05428
	Equal variances not assumed			-.238	.812	-.01272	.05339
PDDCT	Equal variances assumed	5.602	.019	.682	.496	.82506	1.20896
	Equal variances not assumed			.689	.492	.82506	1.19824

PDALLCT	Equal variances assumed	3.375	.069	.647	.519	.84708	1.30857
	Equal variances not assumed			.651	.516	.84708	1.30202
PDRAT	Equal variances assumed	1.507	.222	-1.255	.212	-.05947	.04738
	Equal variances not assumed			-1.256	.211	-.05947	.04734
PEDCT	Equal variances assumed	.493	.484	-1.222	.224	-1.88451	1.54192
	Equal variances not assumed			-1.229	.221	-1.88451	1.53282
PEALLCT	Equal variances assumed	1.851	.176	.164	.870	.34695	2.11343
	Equal variances not assumed			.163	.871	.34695	2.13318
PERAT	Equal variances assumed	2.410	.123	-2.866	.005*	-.21076	.07354
	Equal variances not assumed			-2.878	.005*	-.21076	.07324

APPDCT	Equal variances assumed	1.758	.187	-1.094	.276	-1.06068	.96949
	Equal variances not assumed			-1.085	.280	-1.06068	.97798
APPALLCT	Equal variances assumed	.831	.364	.128	.898	.22046	1.72125
	Equal variances not assumed			.128	.898	.22046	1.71951
APPRAT	Equal variances assumed	.039	.845	-.829	.409	-.05089	.06138
	Equal variances not assumed			-.828	.409	-.05089	.06148
INTDCT	Equal variances assumed	20.989	.000	-2.999	.003*	-1.19623	.39884
	Equal variances not assumed			-2.936	.004*	-1.19623	.40740
INTALLCT	Equal variances assumed	20.804	.000	-3.026	.003*	-1.26181	.41699
	Equal variances not assumed			-2.956	.004*	-1.26181	.42690

INTRAT	Equal variances assumed	2.403	.124	-.666	.507	-.05619	.08440
	Equal variances not assumed			-.667	.506	-.05619	.08421

*P< 0.01 = significant; PI = Problem Identification; PD = Problem Description; PE = Problem Exploration; APP = Applicability; INT = Integration; DCT = Deep Critical Thinking; ALLCT = All Critical Thinking; RAT = Ratio between Deep CT and All CT.

Table 4.11 Linear Regression Analysis of CCTST Scores for Discourse Scores

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
Evaluation for PIDCT	.754	.307	.213	2.452	.016**
Evaluation for APPDCT	.804	.235	.292	3.427	.001*
Method for PERAT	.211	.074	.247	2.866	.005*
Method for INTDCT	1.196	.399	.258	2.999	.003*

Significance level = *p value < .01; **p value < .05

CHAPTER 5: DISCUSSION

Nursing education has as one of its major objectives teaching critical thinking to its students (AACN, 1996). Advanced practice nurses are responsible for assessing, diagnosing, prescribing and implementing plans of care. Hence, it is essential that APNs possess critical thinking skills and are prepared to respond to unfamiliar situations by applying principles and lessons learned from similar clinical situations to the one presently faced. Studies focusing on finding an effective approach to teaching critical thinking and clinical decision-making are found in the literature and are ongoing in nursing, medical and other clinically focused professions.

Critical Thinking in Clinical Education

The mere unpredictability of clinical practice necessitates preparing practitioners to function as competently as possible. Clinical decision-making involves higher cognitive skills, (critical thinking), that are crucial to obtaining positive patient outcomes. Critical thinking is an essential skill for nurses to have because patient situations vary as much as the individuals themselves do. It is impossible to prepare nurses during their training programs for every situation that could be encountered. Assuring that APNs can demonstrate the ability to apply principles and adapt their responses to patient needs is crucial. Thus, if one agrees that critical thinking is important, then the question arises as to whether there are favorable ways to influence its development.

Patient simulation is under substantial consideration as a way of reproducing clinical situations that students can work through with the potential of enhancing critical thinking. Numerous studies have demonstrated patient simulation as a useful tool for skill acquisition (Fletcher, 1995; Monti, Wren, Haas, & Lupien, 1998; Bryans &

McIntosh, 2000; Fallacaro & Crosby, 2000; Nehring, Ellise, & Lashley, 2001; Hotchkiss & Mendoza, 2001; Vandrey & Whitman, 2001; Nelson, 2003; Scherer, Bruce, Graves & Erdley, 2003; Mayo, Hackney, Mueck, Rebaudo & Schneider, 2004; Hall, Plant, Bands, Wall, Kang & Hall, 2005; Murray, Boulet, Kras, McAllister, & Cox, 2005; Barstik, Ziv, Lin, Blumenfeld, Rubin, Keidan, et al., 2005; Crofts, Bartlett, Ellis, Hunt, Fox & Draycott, 2006; Overly, Sudikoff & Shapiro, 2007), but only a few have examined its effect on critical thinking. The concern for teaching critical thinking is not only a nursing issue, but is shared by those in the medical, dental, veterinarian and other clinical professions. Reports of medical and nursing schools, various training centers and hospitals purchasing high fidelity patient simulators continue to flood the literature. Anecdotal accounts by educators on ways to employ simulation or incorporate simulation-based scenarios into curricula are abundant.

Studies have attempted to address the issue of whether simulation may influence critical thinking. Recently, Cioffi, Purcal and Arundell (2005) conducted a study to determine the effects of simulation as a strategy on the clinical decision-making of midwifery students. Subjects were randomly assigned to two groups, one receiving the traditional lectures on normal labor and physiological jaundice, while the experimental group received simulation-based instruction on these topics. A post-test only, control group design was employed. Although the sample size was too small to determine significance, students who learned by the simulated-based instruction reached clinical decisions more rapidly, collected more clinical data as they worked through the scenario, reviewed clinical data less often, made fewer inferences and reported higher confidence levels during the decision-making process.

In another recent evaluation of the effects of simulation in clinical learning, Steadman, Coates, Huang, Matevosian, Larmon, McCullough et al. (2006) set out to determine whether simulation was superior to interactive problem-based learning for teaching medical students acute care assessment and management skills. Through use of random assignment, students were taught by the traditional problem-based learning method or by simulation-based instruction. Using a repeated measures approach, student performance was measured at baseline and again at the final assessment. Baseline measurements were comparable, but the scores obtained by the simulation-based group were higher, suggesting that critical thinking could be enhanced by using simulation.

Measuring Critical Thinking

Measuring the construct of critical thinking has been a challenge to all who have tried. Educators in nursing and other clinically focused fields have tried to measure it, determine whether it changes over time and decide if a particular teaching approach enhances it. Some studies have used qualitative methods of describing a change in critical thinking. Other studies have used quantitative instruments to measure baseline critical thinking and any change in critical thinking that occurred from using a particular approach. The results are varied as much as the measures used. Results ranged from having a measurable positive effect to the opposite extreme in which a decrease in critical thinking was found. These results have been attributed to having a small number of study subjects, unclear definitions of the construct of critical thinking and use of unreliable and invalid tools. Hence, educators question whether critical thinking can be measured or affected.

The current study used Garrison’s definition of critical thinking, which includes five stages that learners progress through during case analysis. The California Critical Thinking Skills Test , used to determine baseline critical thinking scores, includes three elements of clinical reasoning that Garrison stated are included in these stages; induction, inference and deduction. Further, the Critical Thinking Coding Form, adapted by Kamin et al, (2001) is based on Garrison's definition of critical thinking. This tool was used to code behaviors and discourse exhibited by subjects during case analysis. Because the tools used in the current study are based on a similar construct of critical thinking, the results obtained are more robust.

Study Contributions

The evidence, in the current study, suggests that patient simulated approaches to clinical problem solving fostered deep critical thinking activities. The two areas in which this was evident were the problem exploration and applicability stages. Clearly, students addressed the salient components of the clinical situation and displayed greater number of critical thinking behaviors and discussion in simulated scenarios compared to face-to-face sessions. Further, students in these learning situations excelled at integrating and applying the essential components of the clinical cases in a focused problem-solving manner.

The multisensory environment created in simulated settings offers auditory, visual, and tactile input to the participant, as well as providing contextual learning, leading to greater application of knowledge and principles. These sensory inputs appeal to the participants' various learning styles. Participants who learn by hearing and/or seeing are provided the opportunity to observe others in action, listening to dialogue and responding to the sounds and displays of the monitors. The written scenario is given to learners so they can refer to information that they may not be able to remember and meets the needs of those who learn by reading. Those who tend to learn by doing are given the opportunity to respond to the scenario as it unfolds while determining why care is provided in a particular manner. Simulated scenarios can provide learning opportunities that include objectives from the cognitive, affective and psychomotor domains of learning, resulting in a well-balanced and all-encompassing learning experience. Thus, simulation can provide a rich learning experience in which clinicians can be provided with opportunities to implement management strategies and evaluate if the expected results occur.

In the clinical situations in which APNs commonly find themselves, honing in on the salient aspects of patients' conditions or situations and responding in a focused and appropriate manner are essential to obtaining positive outcomes. Inability to ignore extraneous details and to focus one's effort on the most important aspects of a case could result in delay of treatment and cause undue harm to patients. These skills can be further honed by using simulation.

This belief was tested by Steadman and colleagues (2006) who assessed medical student learners' performance in critical assessment described as gathering data, obtaining a past history and history of present illness, performing a physical assessment and performing a diagnostic evaluation; activities that occur during the problem exploration stage of critical thinking. Steadman et al also assessed the learner's ability to develop a management plan. This phase is analogous to the applicability stage of critical thinking described in the current study. Their results were consistent with the present study in that they found the simulation group performed significantly better than the problem-based learning group. Although these studies used different instruments, substantially the constructs measured were analogous and both provide support for the importance of simulation as a learning approach for teaching critical thinking in clinical practice.

The California Critical Thinking Skills Test scores obtained in the current study were statistically significant in the sub scores of inference, induction and deduction. Garrison specifically stated that these three elements of critical thinking were used by learners during the problem exploration phase. Therefore, obtaining baseline critical thinking sub scores could be used to predict the amount of critical thinking that occurs during this pivotal stage of case analysis.

Additionally, in the current study, the evaluation mean score was a statistically significant predictor of deep critical thinking that occurs during the problem exploration and applicability stages ($p<0.05$). Again, these results suggest the utility of obtaining baseline critical thinking scores of learners as a way of predicting those who may or may not do well or those who may require additional attention and instruction.

Implications for Clinical Practice

Some support exists for the use of simulated clinical scenarios as a means of providing opportunities for students to think through situations that they may later encounter in clinical practice. How strong is the evidence for use of simulation for learning in clinical education? In determining this answer, it is important to be aware of recent studies that found improved and efficient learning outcomes with this approach to clinical teaching. These data, while statistically significant, were found in small study populations. Further, it is difficult to compare findings from one study to another, as there is a lack of clarity in the constructs used and inconsistency in the theoretical approaches to clinical learning, as well as inconsistency in the instruments used to measure critical thinking.

Avenues for Future Research

Although the empirical evidence identified a tendency towards improved critical thinking by students taught with simulation, more substantive data are needed to support the broader adoption of simulation as a reliable method for teaching critical thinking. Study results would be more meaningful if the construct of critical thinking could be further unified thereby making the results of studies translatable from one situation to the next.

There are a number of instruments used for measuring critical thinking. Instruments must have high content and construct validity and be highly sensitive to changes in level of critical thinking. Currently it is unclear which of the available tools is the most sensitive and accurate at measuring critical thinking. Further, researchers tend to create additional tools rather than using the ones that have been tested, thus compounding the issue.

Additionally, these sessions have been led by an educator or facilitator. The ability of the facilitator to move the group through the case analysis while teaching key elements and allowing students to think critically is a skill that requires development. It is unwise to think that anyone can teach students how to approach clinical scenarios and solve related problems without training in these techniques. However, many educators assume this role with formal training. Studies examining the attitudes and behaviors of the facilitator during sessions are warranted to ascertain the nuances of the role and to determine the best approach to use when preparing educators for this role.

Recently the effect of debriefing after completion of simulated clinical scenarios has gained much attention. Researchers have conducted primarily small studies, using convenience samples, usually without sufficient power, demonstrating the value of reviewing videotapes of the simulated scenarios with students and providing feedback on performance and decision-making. Additional research is needed to determine the utility of using yet another approach to teaching critical thinking.

Conclusion

Teaching critical thinking skills is recognized as a fundamental objective of programs in which clinically focused care providers are educated. Presently, no one approach has been identified as the best method for preparing providers for the array of situations they may encounter in clinical practice. However, it is acknowledged by educators that more effort must be put forth to produce better-prepared practitioners who can manage the complexity encountered in caring for our society.

Simulation enhanced teaching approaches are hailed in the literature as the answer to this problem. However, little evidence exists that demonstrates its superiority in teaching critical thinking. The current study has provided additional empirical evidence supporting the use of simulation during problem-based learning case study analyses to enhance critical thinking, especially during the problem exploration phase in which APNs formulate creative solutions to the problem, link ideas and make assumptions. Critical thinking was also enhanced during the applicability and problem evaluation stages; the phases in which learners evaluate their accomplishments. Decision-making is a large component of these stages and includes an evaluation of progress and mistakes made, and a determination of what more must be done. By enhancing critical thinking in these two stages, by using simulation, advanced practice nurses can be better prepared to evaluate and solve the problems faced in clinical practice.

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Appendix A Permission to Use Brunner Laboratory

Penn Nursing

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Anne Keane, EdD, FAAN, CRNP, RN
Associate Dean for Academic Programs
Class of 1965 25th Reunion Term Professor in Nursing

June 14, 2004

Drexel University
Institutional Review Board
Philadelphia, PA 19104

Dear Board Members:

This letter is written to confirm that Deborah Becker has obtained permission to use the Mathias J. Brunner Technology Laboratory to conduct her research entitled: The Effect of Incorporating Human Patient Simulation into a Problem-Based Learning Session on the Critical Thinking of Nurse Practitioner Students.

If any additional information is needed, please feel free to contact me via email at akeane@nursing.upenn.edu.

Sincerely,

Anne Keane

Anne Keane, EdD, RN, FAAN
Associate Dean for Academic Programs

UNIVERSITY *of* PENNSYLVANIA

Appendix B Consent Form

Drexel University
And
University of Pennsylvania
Consent to Take Part in a Research Study

Subject Name:____

Title of Research: The Effect of Patient Simulation on the Critical Thinking Of Advanced Practice Nursing Students

Investigator's Name: Fredericka Reisman, PhD
Co-Investigator's Name: Deborah Becker MSN, CRNP
Key Personnel: Debra Abraham, MSN, CRNP
Key Personnel: Carol Ladden, MSN, CRNP

Consenting for the Research Study: This is a long and important document. If you sign it, you will be authorizing Drexel University, University of Pennsylvania and its researchers to perform research sties on you. You should take your time and carefully read it. You can also take a copy of this consent form to discuss it with your family member or any one else you would like before you sign it. Do not sign it unless you are comfortable in participating in this study.

Purpose of Research: You are being asked to participate in a research study. The purpose of this study is to find out if incorporating a patient simulator into a case study analysis session has an effect on the critical thinking of nurse practitioner and nurse anesthesia student participants. Advanced practice nursing programs are employing the use of patient simulators in their curriculum to teach students to critically think about situations in which they may find themselves. However, the effect patient simulation has on the critical thinking of APN students has not been demonstrated Therefore research examining this phenomenon is needed.

Volunteer subjects are being asked to participate in this project in order to determine whether the discussion and behaviors exhibited by students during case analysis sessions are different when the session is conducted in a classroom compared to when the session is conducted in a simulation laboratory with the patient simulator exhibiting symptoms of the patient discussed in the case study.

Volunteer subjects currently enrolled in a graduate degree, nurse practitioner or nurse anesthesia program, who are currently enrolled in or have completed at least one course prior to their participation in this study, may participate. Subjects who have. a prior master's degree in nursing and those subjects who are enrolled in advanced practice nursing master's degree programs that are not nurse practitioner .or nurse anesthesia students are excluded from participation.

This research project is being completed in partial fulfillment to obtain a doctoral degree in educational leadership and learning technologies.

Procedures and Duration: The following procedures will be performed:

- After consent has been obtained and you sip this consent form, you will be asked to complete a demographic data form. Next you will be asked to complete a critical thinking assessment test on-line. This test will take approximately 1 to 1 ½ hours to complete.
- You will then be scheduled, at a time convenient for you, to participate in either a classroom-based or simulation-based case study analysis session. held at the University of Pennsylvania, School of Nursing Mathias J. Brunner Technology Laboratory, Philadelphia, PA.
- Upon arrival to the laboratory, you and four or five other participants will be introduced to the session facilitator and oriented to how the session will be conducted. You will be taken to either the classroom or simulation laboratory. You will be given a copy of the case study to be analyzed. Your group will consider questions about the case study. The group facilitator will guide your group. The session will last approximately 1 hour.
- The session you participate in will be videotaped for future analysis by the investigator and critical thinking discourse and behavior coders.
- Upon completion of the session, your participation in the study will be completed. You will receive a certificate of research participation and a $10 bookstore gift certificate. You also will be entered into a lottery to win either an IPOD or a personal data assistant (PDA).

Risks and Discomforts/Constraints: First you will be asked to complete a demographic data form. then you will be asked to complete an online test followed by participation in a case study analysis session. The test will be scored and the case analysis session will be videotaped. The recognized risk to you is that your demographic data, test score or comments and behaviors in the case analysis session could be divulged. Every effort will be taken to protect you from having any of this information divulged to anyone other than those who are directly involved in the conduction of this study. All demographic data, test results and the session videotapes will be stored in a locked cabinet. After the required; time to maintain the records of this project, all demographic data farms, test results and videotapes will be destroyed.

Unforeseen Risks: In addition to anticipated risks, unforeseen risks could occur. If an unforeseen risk occurs, every effort will be taken to minimize its effect on you.

Benefits: Your participation in this project will provide you with the results of your critical thinking assessment test. Obtaining these results may be beneficial to you.

Alternative Procedures: The alternative is <u>not</u> to participate in this study.

Reasons for Removal from Study: You maybe required to stop before the end of the study for any of the following reasons:

- If all or part of the study is discontinued for any reason by the investigator or university authorities.
- If you are a student, and participation in the study *is* adversely affecting your academic performance.
- If you fail to adhere to requirements for participation established by the researcher.
- If a mutually convenient time for you to participate in the case analysis session is not obtained.

Voluntary Participation: Participation in this study is voluntary, and you can refuse to be in the study or stop at any time. There will be no negative consequences if you decide not to participate or to stop.

Stipend: If you complete the entire study, you will receive a certificate of research participation, a $10 gift certificate to a bookstore and the results of your pre-study critical thinking assessment test. You will be entered into a lottery to win a either an IPOD or personal data assistant (PDA). If you participate in the study and choose to quit any time before the end, you will receive the results of your critical thinking assessment test.

Responsibility for Cost: You will be responsible for the cost of transportation to the University of Pennsylvania, School of Nursing Mathias J. Banner Technology Laboratory.

In Case of Injury: Drexel University and the University of Pennsylvania will not be responsible for costs related to any injury that occurs as a result of your participation in this study.

Confidentiality: In any publication or presentation of research results, your identity will be kept confidential, but there is a possibility that records which identify you may be inspected by authorized individuals such as the institutional review boards (IRBs), or employees conducting peer review activities. You consent to such inspections and to the copying o f excerpts of your records, if required by any of these representatives.

Every effort will be taken to protect you from having any of this information divulged to anyone other than those who are directly involved in the conduction of this study. All demographic data, test results and the session videotapes and coding sheets will be stored in a locked cabinet. After the required time to maintain the records of this project has been met, all demographic data forms, test results, coding forms and videotapes will be destroyed.

Other Considerations: If you wish further information regarding your rights as research subject or if you have problems with a research-related injury, Please contact the Institution’s Office of Research Compliance by telephoning 215-762-3453.

Consent:

I have been informed of the reasons for this study.

I have had the study explained to me.

I have had all of my questions answered.

I have carefully read this consent* form, have initialed each page, and have received a signed copy.

I gave consent/*permission* voluntarily to participate in this study and to be videotaped.

____________________________________ ____________________

Subject or Legally Authorized Representative Date

____________________________________ ____________________

Person Authorized to Obtain Consent/*Permission* Date

____________________________________ ____________________

Witness to Signature Date

List of Individuals Authorized to Obtain Consent/*Permission*

Name	Title	Day/Phone#	24 Hr Phone #
Deborah Becker	Investigator	609-313-4321	609-313-4321
Debra Abraham	Key Personnel	610-446-2817	610-446-2817
Carol Ladden	Key Personnel	215-901-5732	215-901-5732

Appendix C Demographic Data Form

The Effect of Human Patient Simulation on the Critical Thinking
of Advanced Practice Nursing Students

Each participant in this study must complete this demographic form. All information will be kept confidential. The information provided on this form will be used for the purposes of this study only.

Name: Address: Email Address:	Phone numbers: Home: Cell: Work:	Age: _______ Gender: Male 1__ Female 2__

Race: 1 __ White 2 __ Latino 3 __ Black 4 __ Asian (Chinese, Japanese, Korean, South East Asian) 5 __ Native American, Aleutian, Eskimo 6 __ Other, please specify ____	Years of Previous Nursing Experience: 1 __ 0-2 4 __ 10-15 2 __ 2-5 5 __ 15-20 3 __ 6-10 6 __ > 20
Most Recent Area of Nursing Experience: 1 __ Critical Care 2 __ Surgery 3 __ Orthopedics 4 __ Renal 5 __ Cardiac 6 __ Pulmonary 7 __ Neurology 8 __ Neurosurgery 9 __ Transplant 10 __ Oncology 11 __ Pediatrics 12 __ Women's Health 13 __ Primary Care 14 __ Other, please specify: ____________	Type of Nurse Practitioner Program Enrolled: 1 __ Acute Care 2 __ Critical Care 3 __ Gerontology 4 __ Primary Care, Family 5 __ Primary Care, Pediatrics 6 __ Primary Care, Adult 7 __ Women's Health 8 __ Oncology 9 __ Pediatric Oncology 10 __ Pediatric Critical Care 11 __ Emergency 12 __ Psychiatric 13 __ Perinatal/Neonatal 14 __ Other, please specify: _______
Number of courses completed: ____ Number of courses in program: ____ Started clinical courses: Yes __ / No __ Previous experience with a human simulator: Yes ___/No___ If yes, what type: _________________	NP Program Grade Point Average (GPA): 3.75 - 4.00 __ 3.00 - 3.24 __ 3.50 - 3.74 __ 2.75 - 3.00 __ 3.25 - 3.49 __ 2.50 - 2.99 __ < 2.49 __

Appendix D Orientation to Case Analysis Sessions

Orientation to the Case Analysis Session - Face-to-Face

1. Introduce self and other members of the group to one another. Allow a few minutes for the group to get to know what program each other is in, what year in their respective programs and to settle in to their surroundings.
2. Put name tags on.
3. Explain that this group will be discussing a particular patient focused case study in which the patient is having a health-related issue. Each member of the group will be given a copy of the case analysis to be discussed. They are able to write down notes on this sheet. They can ask questions. If the information is available, they will be given that information. If the information is not available, they will continue with the case study analysis without that information.
4. The goal of the case study analysis is to manage the patient's health status while working through the questions at the bottom of the page.
5. Everyone is encouraged to participate as much as they feel comfortable.
6. The group will be encouraged to consider each other's answers and questions and to come to agreement on how to manage the patient.
7. The role of the facilitator is to help clarify information, provide additional information as available and to help guide the group if and when help is needed.
8. The session will last for no more than 1 hour; no less than 50 minutes.
9. The entire session will be videotaped.
10. At the end of the hour, the facilitator will wrap up the session, will collect copies of the case study and dismiss the group.

Orientation to the Case Analysis Session - Simulation Centered

1. Introduce self and other members of the group to one another. Allow a few minutes for the group to get to know what program each other is in, what year in their respective programs and to settle in to their surroundings.
2. Put name tags on.
3. Explain that this group will be discussing a particular patient focused case study in which the patient is having a health-related issue. Each member of the group will be given a copy of the case analysis to be discussed. They are able to write down notes on this sheet. They can ask questions. If the information is available, they will be given that information. If the information is not available, they will continue with the case study analysis without that information.

   The simulator will be exhibiting the signs and symptoms the patient is having in the case. The simulator can be examined during the session. The patient simulator has palpable pulses, heart, lung and bowel sounds, has the ability to be intubated, have IVs placed, have a urinary catheter or NGT placed. It can be repositioned, the bed can be raised or lowered. There are stethoscopes, monitors and supplies available in the room if they any are needed.

4. The goal of the case study analysis session is to manage the patient's health status while working through the questions at the bottom of the page.
5. Everyone is encouraged to participate as much as they feel comfortable.
6. The group will be encouraged to consider each other's answers and questions and to come to agreement on how to manage the patient.
7. The role of the facilitator is to help clarify information, provide additional information as available and to help guide the group if and when help is needed.
8. The session will last for no more than 1 hour; no less than 50 minutes.
9. The entire session will be videotaped.
10. At the end of the hour, the facilitator will wrap up the session, will collect copies of the case study and dismiss the group.

Appendix E Case Studies A and B

Case A.

A 57 year old man with long-term, poorly controlled hypertension developed sudden, severe pre-cordial chest pain radiating to the back while doing gardening work. He denies shortness of breath, lightheadedness, dizziness, nausea or vomiting. He denies radiation of the pain to any part of his body.

This is the first time this has ever happened. He tried resting without relief. His wife called 911 and EMS brought him to the hospital. His past medical history is positive for hypertension, which has been controlled with a thiazide diuretic.

You are called to see this patient in the Emergency Department as EMS is bringing him in. He is pale, diaphoretic and hypotensive.

Elements to consider:

1. What are the salient aspects of this case that require attention? What, if any additional information would you want to know about this patient and his status?

2. Determine the top five differential diagnoses based on this patient's symptoms.

3. What is your priority care issue for the patient? Why?

4. Based on your answer in #3, discuss your top 5 interventions and the rationale for them.

5. Describe the evaluation criteria to be used to determine the patient is responding appropriately to your therapy.

Case B.

A 62-year-old man with severe chronic obstructive pulmonary disease presents to the pulmonary clinic for follow-up after beginning home oxygen therapy.

His only hospitalization occurred 8 months earlier during an acute flare that resolved without the need for intubation. Despite aggressive medical therapy and a trial of pulmonary rehabilitation, his dyspnea had progressed to the point that it is now present when he is at rest. In light of his declining function, you ask him how he would like to be treated in the event his disease suddenly deteriorates. The patient responds that he does not want to be intubated or resuscitation. His wife nods in agreement but does not participate in the discussion. You note in the patient's chart that he has a requested a "do not intubate/do not resuscitate" status.

A month later, you are paged to the emergency department to see this patient. Paramedics brought him to the hospital after his wife called 911. A week ago he developed cold symptoms followed by an increase in his cough with frankly purulent sputum. He slept in a chair the past 2 nights and appears severely dyspneic. You remember the discussion from a month ago. However, when you speak to him briefly, he asks that everything be done.

Elements to consider:

1. What are the salient aspects of this case that require attention? What, if any, additional information would you want to know about this patient and his status?

2. Determine the top five (5) differential diagnoses for this patients symptoms.

3. What is your priority care issue for the patient? Why?

4. Based on your answer in #3, Discuss your top 5 interventions and the rationale for them.

5. Describe the evaluation criteria to be used to determine the patient is responding appropriately to your therapy.

Vita

Deborah Ellen Becker was born in Coatesville, PA on September 13, 1960. Ms. Becker is a citizen of the United States of America. Ms. Becker graduated from Villanova University with a Bachelors of Science in a General Program in 1982. She attended Thomas Jefferson University School of Allied Health where she obtained a Bachelors of Science in Nursing in 1984. Ms. Becker attended the University of Pennsylvania School of Nursing and obtained a Master's of Science in Nursing in Critical Care in 1991. In 1998, Ms. Becker obtained a post-master's certificate as a Critical Care Nurse Practitioner and she completed a post-master's certificate in the Teacher Education Program in 1999, both at the University of Pennsylvania School of Nursing. In 2002, Ms. Becker enrolled in the Educational Leadership and Learning Technologies Doctorate of Philosophy program at Drexel University School of Education, which she completed in the May 2007.

Ms. Becker worked as a staff nurse at Graduate Hospital, in Philadelphia, PA from 1984 through 1991, first on a cardiac medical surgical unit and then in the Coronary Care Unit. She joined the nursing education department in 1991. She transferred back to the Coronary Care Unit in 1996. In 1994, Ms. Becker became clinical faculty for the University of Pennsylvania School of Nursing's senior clinical practicum course. She expanded her role to course assistant, seminar leader and clinical site coordinator. In 1997, she became course director of an advanced technologies course in the Critical Care Nurse Practitioner program and became Assistant Program Director in 1998. In 2000, she became the Assistant Program Director of the Acute Care Nurse Practitioner Program. She served as the Interim Director in 2003 and since 2004 she has been the Director of the Acute Care NP program. Ms. Becker's interest in simulation began when she directed a course that examined the use of technology in critical care and relied heavily on the use of simulation to teach skills and decision making associated with technology. This interest fueled her dissertation topic.

Ms Becker has been recognized for her teaching when she received the Provost Award for Distinguished Teaching at the University of Pennsylvania in 2004.

Ms. Becker has published on several acute care topics and nurse practitioner role issues. She is active in the American Association of Critical Care Nurses and in advanced practice as her publications reflect.